

Appendix E

Transportation Appendices

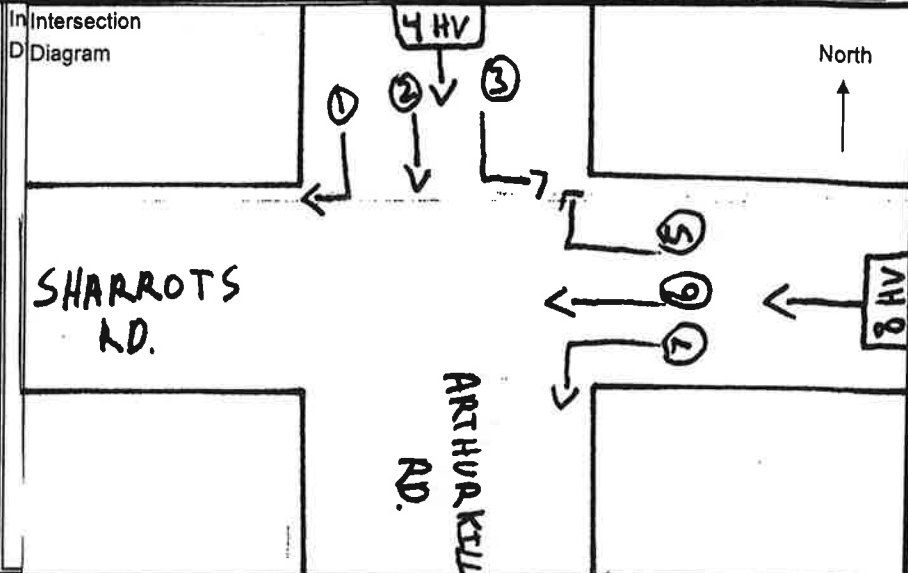
Turning Movement Counts

Date: 06/08/11

Period: AM

Weather Conditions: *Sunny - 91°F*

Surveyor's Name: Tetiana Beneditska

[illegible]

Intersection
Diagram

Date:

06/08/11

Period: MD

SHAROTS
L.D.

Weather Conditions:

sunny t-91°F

Tetiana

Surveyor's Name: Benedulsko

ARTHUR KELL
AD.

North

[illegible]

Date:

06/08/11

Period: PM

PM

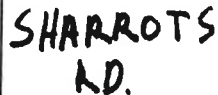
Weather Conditions:

sunny-97°F

Surveyor's Name:

Tatiana
Benedytska

Intersection Diagram



ARTHEUR
P.

North

[illegible]

(1A)

Project No.: 1121A

Date: June 04, 2011

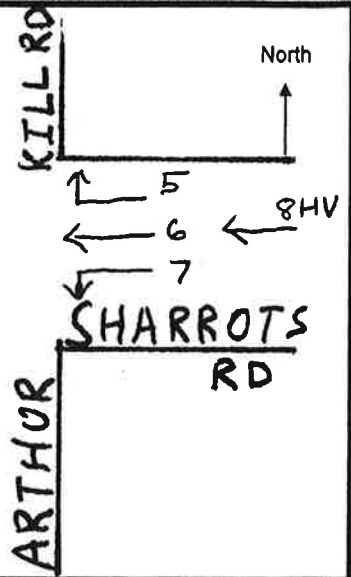
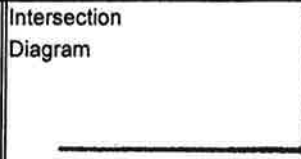
Period: PM

Weather Conditions: fine

Surveyor's Name: Alexander Pushkin

toll: \$8⁰⁰
mileage: 98ml

HV - Count vehicles
w/ more than
4 wheels
(Heavy Vehicles)



		Movements											
Time		1	2	3	4	5	6	7	8	9	10	11	12
3:00 to 3:15		5	40	6	+	6	2	8	-				
3:15 to 3:30		6	45	8	1	8	3	8	-				
3:30 to 3:45		2	39	6	-	10	3	16	-				
3:45 to 4:00		3	35	5	4	7	3	14	-				
4:00 to 4:15		6	29	6	4	9	3	8	-				
4:15 to 4:30		3	34	6	1	7	5	6	-				
4:30 to 4:45		6	36	6	1	3	-	6	-				
4:45 to 5:00		3	30	6	2	9	2	17	-				
5:00 to 5:15		2	32	3	2	12	3	15	-				
5:15 to 5:30		2	22	6	1	2	2	9	-				
5:30 to 5:45		3	25	2	1	8	2	7	1				
5:45 to 6:00		2	27	3	1	3	1	4	-				
Peak Hour													

toll: \$8⁰⁰
mileage: 98ml

[illegible]

[illegible]

[illegible]

Intersection Diagram

Arthur kill Rod

⑤ ⑥

↓ ↓

③ ④

Angelina
Astashova

[illegible]

Intersection Diagram

Date: 06/02/11

Period: 7:00 AM

Weather Conditions:

Surveyor's Name:

Inna Sackar

ALLENTOWN LN.

ARTHUR KILL

North

VETERANS RD
WEST

Movements

[illegible]

Date: 06/07/11

Period: 11 30 MD 30

Weather Conditions:

Surveyor's Name:

re: Ilma Siskka

Intersection Diagram

ALLENTOWN LN.

ARTHUR KILL

North

VETERANS RD
WEST

Movements

[illegible]

Date: 06/07/11

Period: 16³⁰ PM 18³⁰

Weather Conditions:

Surveyor's Name:

ne: Inna Sichkan

Intersection Diagram

ALLENTOWN LN.

ARTHUR KILL

North

VETERANS RD
WEST

Movements

[illegible]

Project No.: 1121A

Date:

06/04/11

Period:

3 PM 6

Weather Conditions:

Surveyor's Name:

e: Inna Sichter

Intersection Diagram

ALLENTOWN LN

ARTHUR KILL

12

North

VETERANS RD
WEST

WEST

D

2

③

[illegible]

[illegible]

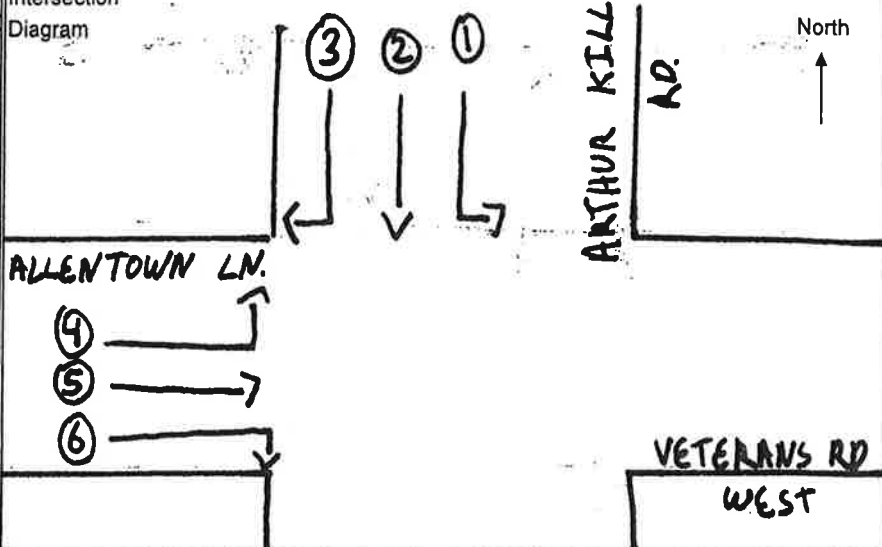
Date: 06/07/11

Period: MD

Weather Conditions:

Surveyor's Name:

Intersection
Diagram

[illegible]

Date: 06/07/11

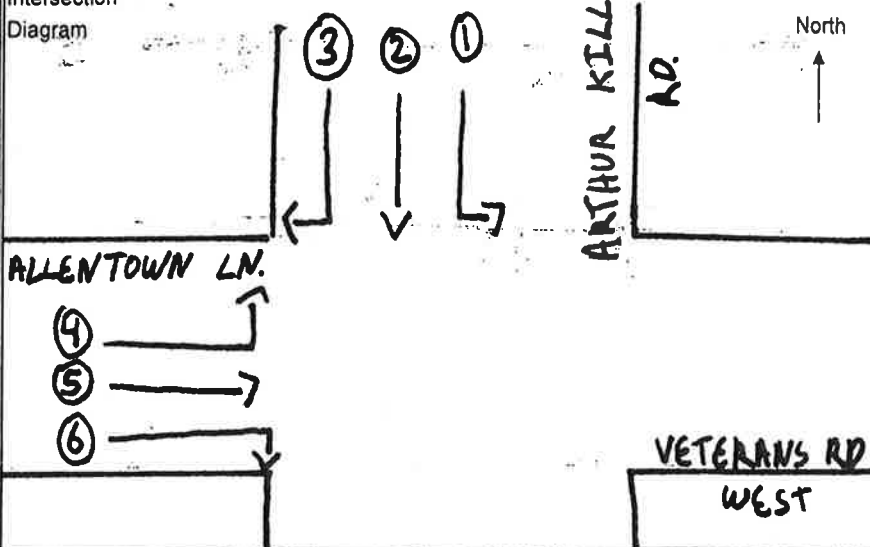
Period: PM

Weather Conditions:

Surveyor's Name:

Dynodmila
Racher

Intersection
Diagram

[illegible]

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

Intersection Diagram



ARTHUR KILL RD

North

VETERANS RD
WEST

[illegible]

[illegible]

Surveyor's Name:

LAMAKINA

HV - Count vehicles w/
More than 4 wheels

ARTHUR KILL RD

↓ 8 HV
↓ 7

↑ 5
↑ 6 HV

$\begin{array}{cc} \swarrow 3 & \swarrow 4H \\ \searrow 1 & \searrow 2HV \end{array}$
N. BRIDGE
 ST

[illegible]

(5)

Project No.: 1121a

Date: 06/07/11

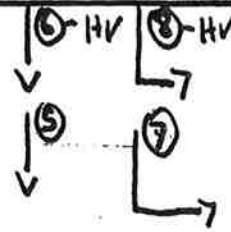
Period: MD

Weather Conditions: sunny
Tetiana

Surveyor's Name: Berneolika

Intersection
Diagram

ARTHUR KILL RD



North

S. BRIDGE
ST.

Movements

Time	1	2	3	4	5	6	7	8	9	10	11	12
11:30 to 11:45	71	10	40	5	103	9	26	8				
11:45 to 12:00	53	9	28	—	114	8	30	5				
12:00 to 12:15	70	10	56	3	99	10	45	5				
12:15 to 12:30	69	9	45	1	112	10	33	6				
12:30 to 12:45	69	6	38	2	105	2	23	2				
12:45 to 13:00	77	7	50	4	101	5	30	8				
13:00 to 13:15	64	3	27	2	102	3	29	6				
13:15 to 13:30	66	3	30	—	107	5	43	5				
Peak Hour												

Intersection Diagram

Period: PM

Weather Conditions:

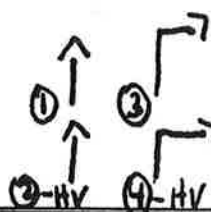
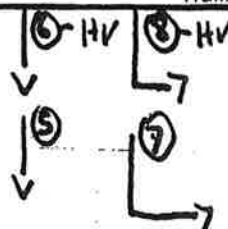
Surveyor's Name:

stunning

Tetiana

Benedińska

ARTHUR KILL RD



North
↑

S. BRIDGE
ST.

[illegible]

Project No.: 1121A

Date: 06/04/17

Period: PM

Weather Conditions:

ns: cloudy

Surveyor's Name:

Tetiana
Beneditska

Intersection Diagram

H/V - Count vehicles w/ more than 4 wheels (Heavy Vehicles)

ARTHUR KILL RD

↓ 6 HV 8 HV
↓ 5 7

$1 \uparrow$ $3 \nearrow$
 $2HV \uparrow$ $4HV \nearrow$

S. BRIDGE

North
↑

[illegible]

[illegible]

[illegible]

Project No.: 1121A

**Intersection
Diagram**

Date: 6-9-2011

Period: PM

Weather Conditions:

Surveyor's Name:

Name: Victor Kouliko ✓

Arthur Kill Rd

Movements

[illegible]

Date: 6-7-11

Period: AM

Weather Conditions:

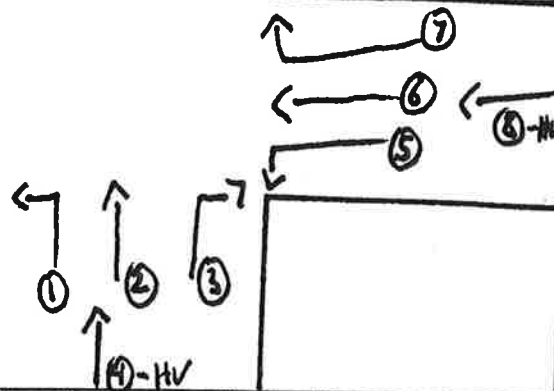
Surveyor's Name: Denis Volchanskiy

Intersection Diagram

RICHMOND
VALLEY RD.

PAGE AVE

North

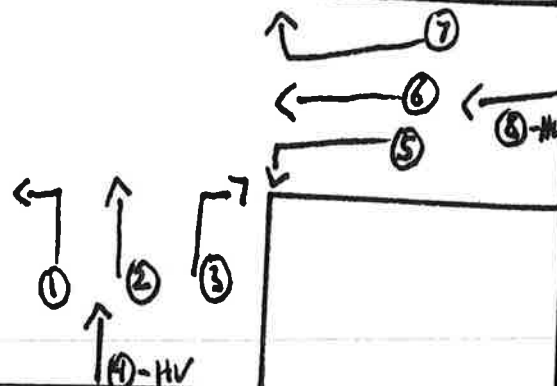
[illegible]

Surveyor's Name:

RICHMOND
VALLEY RD.

PAGE AVE

North

[illegible]

[illegible]

[illegible]

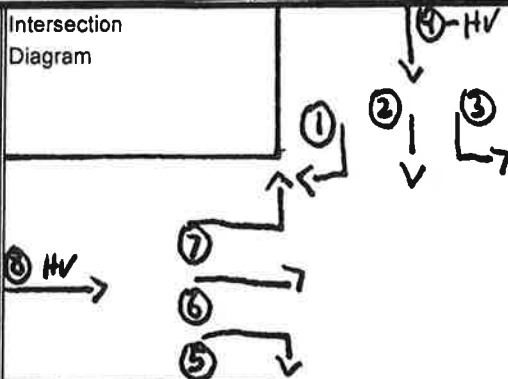
Date: 06-07-2011

Period: AM

Weather Conditions:

Surveyor's Name: Driver ~~T~~\$13.0 ; 65. ML
Oleg Volchonskiy

Intersection Diagram



North

RICHMOND
VALLEY RD

PAGE AVE

[illegible]

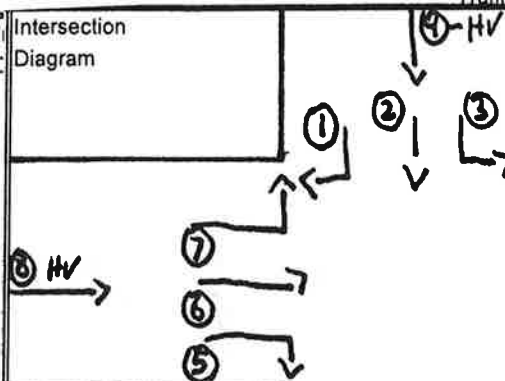
Date:

Period: MD

Weather Conditions:

Surveyor's Name:

Intersection
Diagram



North

RICHMOND
VALLEY RD

PAGE AVE

[illegible]

Date: 6-4-2011

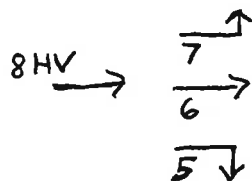
Period: PM

Weather Conditions:

Surveyor's Name:

Denis Volchansky

Intersection Diagram



HV - Count
Vehicles w/ more
than 4 wheels
(Heavy Vehicle)

↓ 4HV

1 2 3

North

RICHMOND
VALLEY RD

PAGE AVE

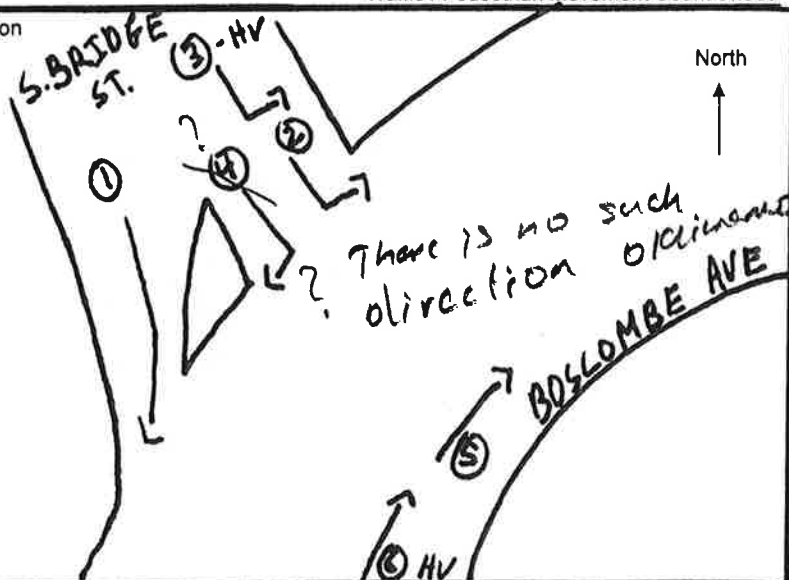
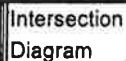
[illegible]

Date: June 7, 2011

Period: AM

Weather Conditions:

Surveyor's Name: Olga Klimanova

[illegible]

Project No.: 1121a

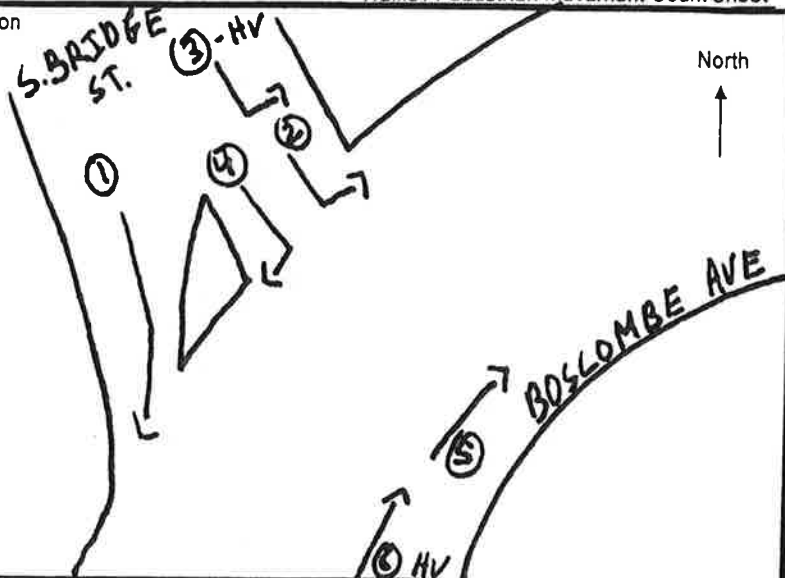
**Intersection
Diagram**

Date:

Period: MD

Weather Conditions:

Surveyor's Name: Olga Klimenko

[illegible]

[illegible]

(9A)

[illegible]

Project No.: 1121a

Intersection Diagram

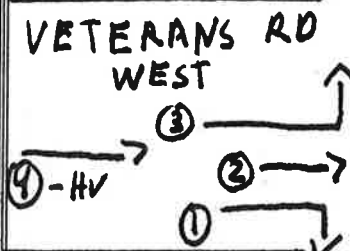
Date: 06/07/11

Period: PM

Weather Conditions:

Leonid Gurevich.

Surveyor's Name:



MOHA

ST	(5)	(6)	(7)
←	↓	↓	↓

North

[illegible]

Date: 6-9-2011

Period:

PM

PM
Julia Borodonez

Weather Conditions:

100 Dazzow Pl
Apt 12 D

Surveyor's Name:

Bronx NY 10475

Intersection

Diagram

HV - Count vehicles w/ more than 4 wheels. (Heavy Vehicles)

VETERANS RD
WEST

3

→

4HV 2

39

072

BR



MOHRST

五

4

5

11

1

North

Movements

[illegible]

North

VETERANS RD
WEST

Weather Conditions: 100 DARRON PLACE
APT. 12D
BRONX, NY 10475

Surveyor's Name: KUSHNIR SOFIA

15
V. Anderson

11X3
4/24/22

[illegible]

[illegible]

Intersection Diagram

Date:

06/4/11

Period: PM

Weather Conditions:

APT. 12D
BRONX, NY 10475

Surveyor's Name: SOFIA KUSHNIR

100 DARROW PL.

IV. BRIDGE ST

HIGHWAY
EXIT

North

Movements

[illegible]

Date:

06/07/11

Period: AM

Weather Conditions:

Surveyor's Name:

Mikhail Shapiro

Intersection Diagram

North

MOHR ST

← 7 8 →

TYRELLAN
AVE

[illegible]

[illegible]

Date:

06/07/11

Period: PM

Weather Conditions:

Surveyor's Name:

Michael Shapiro

Intersection Diagram

North

MOHR ST

← 7 8 →

TYRELLAN
AVE

[illegible]

10

Intersection Diagram

HV - Count vehicles w/ more than 4 wheels (Heavy Vehicles)

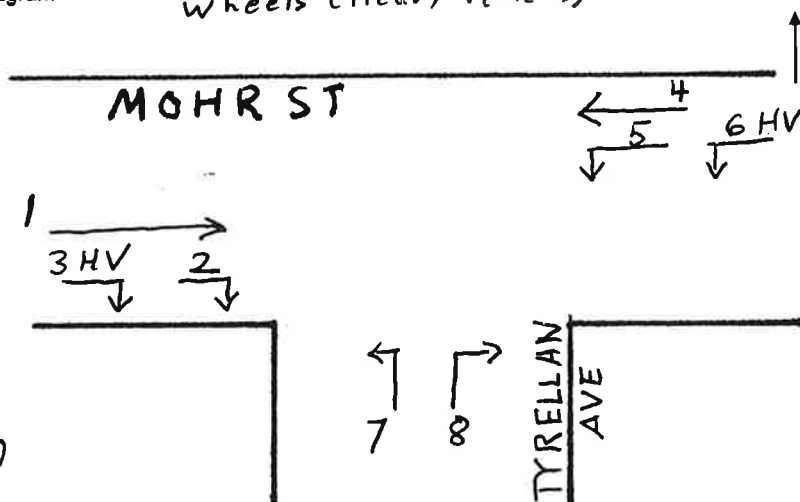
Date: 06/09/11

Period: PM

Weather Conditions:

Surveyor's Name:

Michael Shapiro

[illegible]

Date:

06.07.11

Period: PM

Weather Conditions:

Surveyor's Name: Dmitriy Kobtsev

Surveyor's Name:

Intersection
Diagram

TYRELLAN
Ave

North

VETERANS AD
WEST

Movements

[illegible]

11A

Intersection
Diagram

Date: 6-4-2011

Period: PM

Weather Conditions:

Surveyor's Name: Dmitriy Kobtsev

VETERANS RD WEST

$\xrightarrow{HVZ}$

4	$\nearrow$
5	$\rightarrow$
6	$\searrow$

HV - Count Vehicles
w/ more than
4 wheels
(Heavy Vehicles)

North

TYRELLAN
AVE

[illegible]

11B

Intersection
Diagram

North

Date:

Period:

PM

Weather Conditions:

Surveyor's Name _____

YELENA KRAYCHIK

VETERANS RD WEST

TYRELLAN

← ↑ →
6 5 4

[illegible]

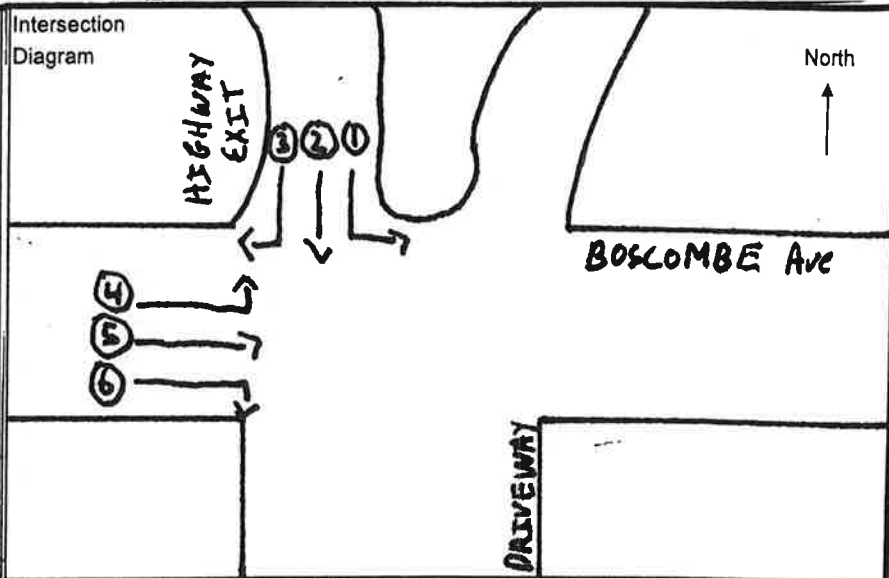
(12-A)

Date: 06/07/11

Period: 7:30 AM 18³⁰ p.m.

Weather Conditions:

Surveyor's Name: Bogdan Oleksuk

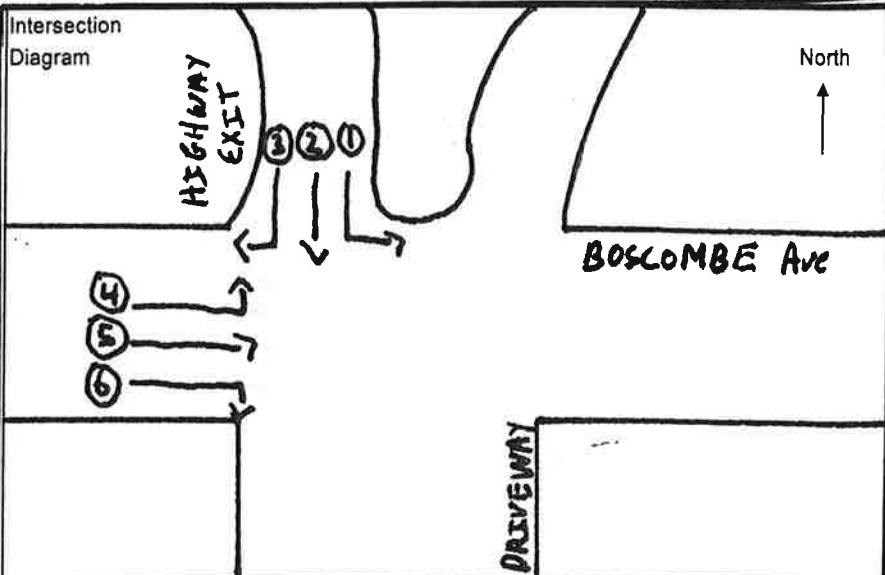
[illegible]

Date: 06/07/11

Period: MD

Weather Conditions:

Surveyor's Name: Bogdan Oleksuk

[illegible]

MIATTE Toll - \$13
Mileage - 43 m

12A

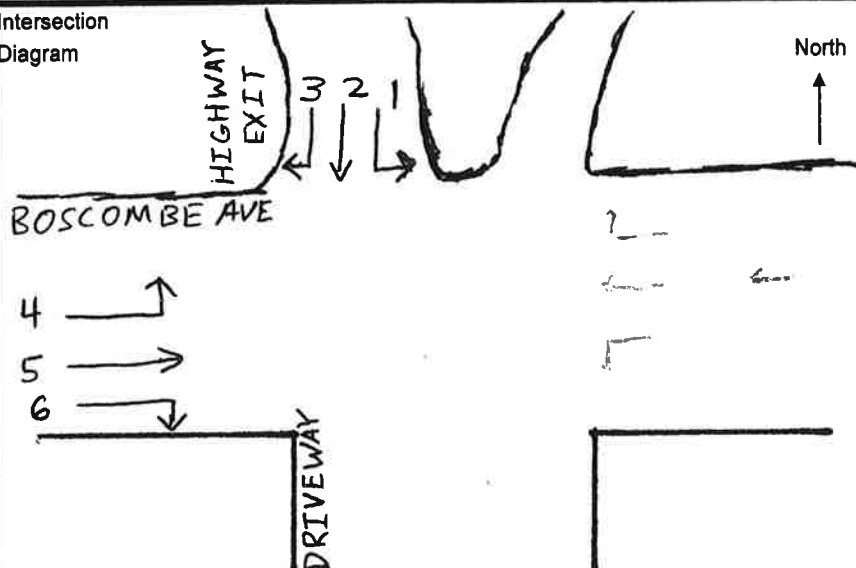
Intersection Diagram

Date: 06/04/11

Period: 3-6 PM

Weather Conditions:

Surveyor's Name: Bogdan Oleksuk

[illegible]

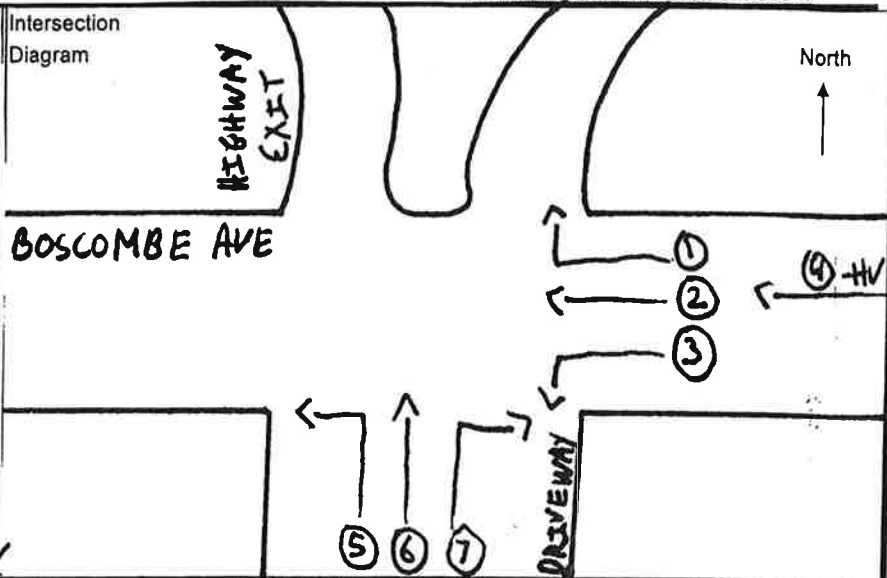
Date:

Period: AM

Weather Conditions:

Surveyor's Name:

Victor Koulikov

[illegible]

EX-117
KWHWY

BOSCOMBE AVE

North

Period: PM

Weather Conditions:

Surveyor's Name: Victor Koulaikov

Movements

Time	1	2	3	4	5	6	7	8	9	10	11	12
16:30 to 16:45	74	85	-	2	-	1	-					
16:45 to 17:00	61	76	-	-	-	-	-					
17:00 to 17:15	80	71	1	1	1	2	1					
17:15 to 17:30	73	70	-	-	-	-	-					
17:30 to 17:45	94	67	-	-	-	1	1					
17:45 to 18:00	82	79	-	1	1	-	-					
18:00 to 18:15	72	73	-	2	-	-	-					
18:15 to 18:30	66	55	-	-	-	-	-					
Peak Hour							/					

12B

Intersection Diagram

6/4/11

Зрм - брм

Surveyor's Name:

Marianna Krasik

HV - Count + vehicles
w/ more than 4
wheels
(Heavy Vehicles)

DRIVEWAY

← 5 ↑ 6 → 7

North

[illegible]

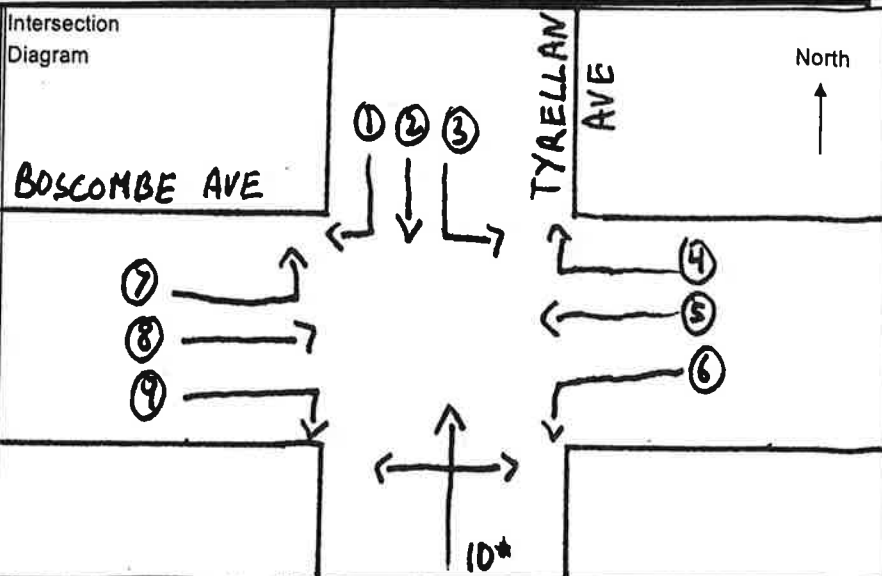
Date: 6/7/11

Period: AM

Weather Conditions:

Weather Conditions: 60 miles \$ 9.60 Ver. Bridge Toll

Surveyor's Name: Igor Slavin - driver

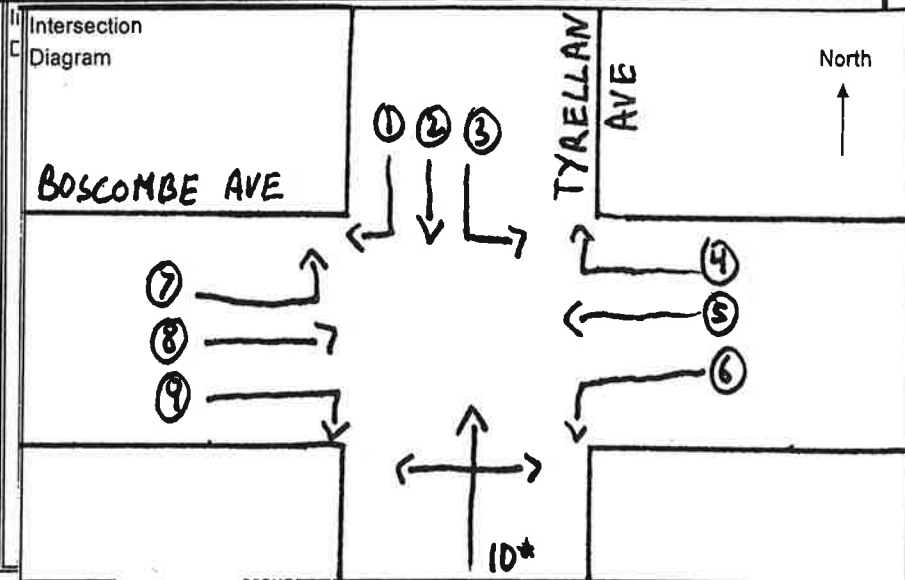
[illegible]

Date: 6/7/11

Period: MD

Weather Conditions:

Surveyor's Name: Igor Slavin

[illegible]

Date: 6/7/11

Period: PM

Weather Conditions:

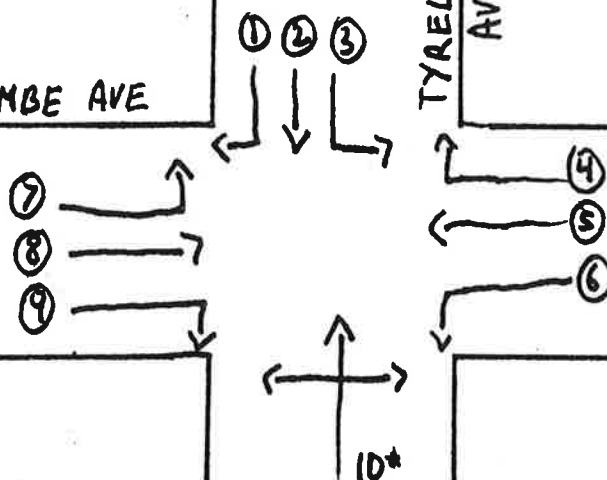
Surveyor's Name: Igor Slavov



BOSCOMBE AVE

ELLAN
AVE

North



movements

[illegible]

Date: 6-4-2011

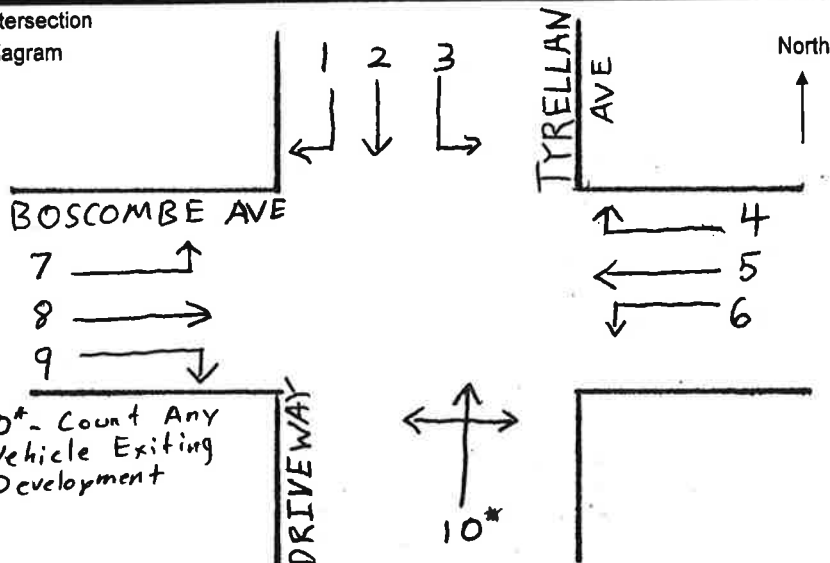
Period: PM

Weather Conditions:

Surveyor's Name:

Surveyor's Name: Igor Slavin - driver

Intersection Diagram

[illegible]

Date: 06/07/11

Period: 7³⁰-9³⁰ AM

Weather Conditions:

Surveyor's Name: Alex Taft

Intersection Diagram

MOHR ST

VETERANS AD
WEST

North

Movements

[illegible]

Date:

Period: 11/20 MD/ 30

Weather Conditions:

Surveyor's Name:

1121a

Intersection Diagram

MOHR ST

Traffic / Pedestrian Movement Count Sheet

North

VETERANS AD
WEST

[illegible]

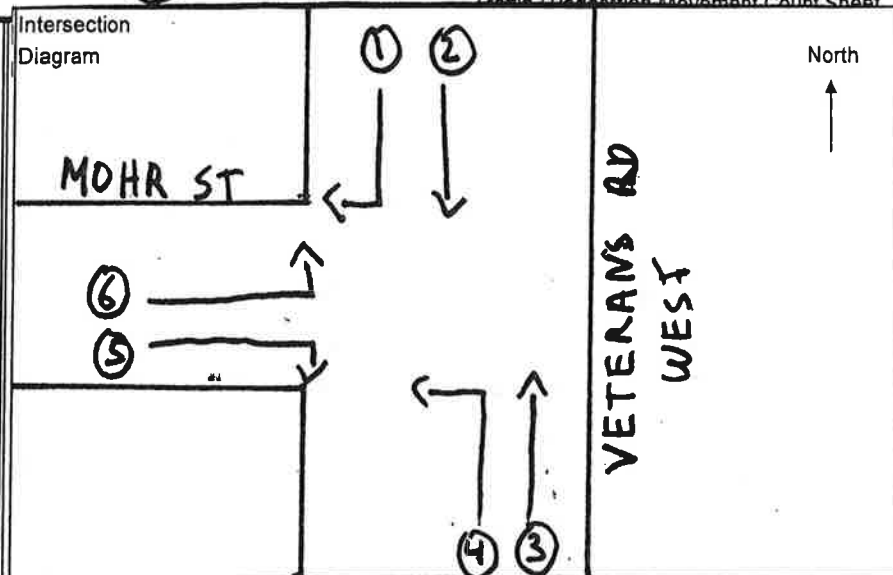
Intersection Diagram

06/07/11

4:30 PM 6-30

Surveyor's Name:

Alex Taft

[illegible]

Project No.: 1053

Date: 06/28/11

Period: PM

Weather Conditions:

Leonid Gurevich.

Surveyor's Name:

Intersection Diagram

DEAD
END

HV - Count Vehicles
w/ more than
4 wheels
(Heavy Vehicles)

VETERANS RD
WEST

North

ENGLEWOOD AVE

[illegible]

15

Date: 06/08/11

Period: PM

Weather Conditions:

Surveyor's Name:

Leonid Gurevich

Intersection Diagram

DEAD
END

HV - Count Vehicles
w/ more than
4 wheels
(Heavy Vehicles)

VETERANS RD
WEST

ENGLEWOOD AVE

North

[illegible]

Project No.: 1053

Date: 06/08/11

Period: PM

Weather Conditions:

Leonid GUREVICH.

Surveyor's Name:

Intersection
Diagram

DEAD
END

HV - Count Vehicles
w/ more than
4 wheels
(Heavy Vehicles)

VETERANS RD
WEST

ENGLEWOOD AVE

North

[illegible]

Intersection Diagram

Date: 06.11.2011

Period: PM

Weather Conditions:

Surveyor's Name:

Full Name: Alisher
Khamidullaev

DEAD END

HV- Count vehicles
w/ more than 4
wheels
(Heavy Vehicles)

VETERANS RD
WEST

ENGLEWOOD AVE

North

[illegible]

[illegible]

Project No.: 1053

Intersection
Diagram

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

Andrey Butko

HV - Count Vehicles
w/ more than
4 wheels
(Heavy Vehicles)

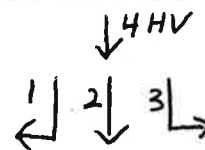
VETERANS
RD WEST

North

[illegible]

Surveyor's Name: Driver: Toll \$13.00; 65 ML
Volchansting

HV - Count Vehicles
w/ more than
4 wheels.
(Heavy Vehicles)



VETERANS
RD WEST

[illegible]

17

Traffic / Pedestrian Movement Count Sheet

Project No.: 1053

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

Intersection Diagram

SHARROTS RD

RD EAST

North

↑ 1

← 2

VETERANS

[illegible]

Project No.: 1053

Intersection Diagram

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

SHARROTS RD

RD EAST

North

← 2

VETERANS

← 5 ↑ 4 ↗ 3

[illegible]

Intersection Diagram

Date:

Period: PM

Weather Conditions:

Surveyor's Name:



RD EAST

North

VETERAN

[illegible]

Intersection Diagram

Date: 06-08-11

Period: AM

Weather Conditions:

Surveyor's Name:

Driver: Toll \$13.0, 70mL
Oleg Volchanisky

ENGLEWOOD AVE

RO EAST

North

VETERANS

[illegible]

VETERANS

[illegible]

Project No.: 1053

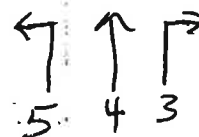
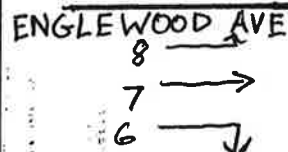
Intersection Diagram

Date:

Period: PM

Weather Conditions:

Surveyor's Name:



RO EAST

VETERANS

North

[illegible]

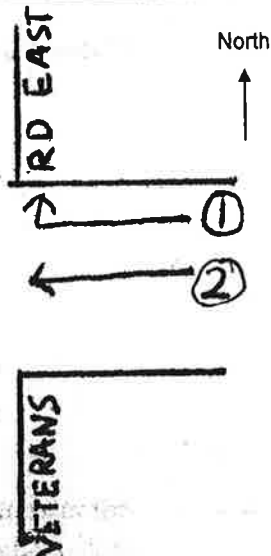
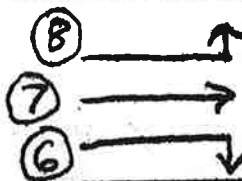
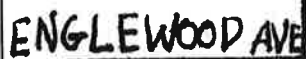
Intersection Diagram

Date: 06.11.2017

Period: PM

Weather Conditions:

Surveyor's Name:



Movements

[illegible]

Intersection Diagram

Date: 06/08/11 Wen

Period: 7:30 AM - 9:30 AM

Weather Conditions:

Sunny, 75°F

ALEXANDRE BOURDAKOV
Surveyor's Name: DRIVER - 89 mls

ENGLEWOOD AVE

BLOOMINGDALE RD

North

(S 13) - poll of VERIZON customers BRN DFB

[illegible]

Project No.: 1053

Intersection Diagram

Date: 06/08/11 wen.

Period: 4:30 PM - 6:30 pm

Weather Conditions: *Sunny, 99°F.*

ALEXANDRE BOURDAKOV
Surveyor's Name: DRIVER

ENGLEWOOD AVE

BLOOMINGDALE RD

North

[illegible]

19

North
↑

Intersection Diagram

Date:

Period:

Weather Conditions:

Surveyor's Name:

ENGLEWOOD AVE

BLOOMINGDALE RD

[illegible]

20

[illegible]

20

[illegible]

Date: 6.8.11

Period: PM

Weather Conditions:

Surveyor's Name: Dmitriy Kobtsev

Intersection Diagram



22

DRUM GOOLE
RD WEST

BLOOMINGDALE

North

↑ 3
← 4
↓ 5

[illegible]

21A

Traffic / Pedestrian Movement Count Sheet

Project No.: 1053

Date:

6.8.11

Period: PM

Weather Conditions:

Surveyor's Name: Dmitriy Kobtsev

Surveyor's Name:

Intersection Diagram

VETERANS RD
EAST

22

DRUM GOOLE
RD WEST

North

BLOOMINGDALE

3
4
5

5

5

[illegible]

(212)929-5656

21A

Intersection Diagram

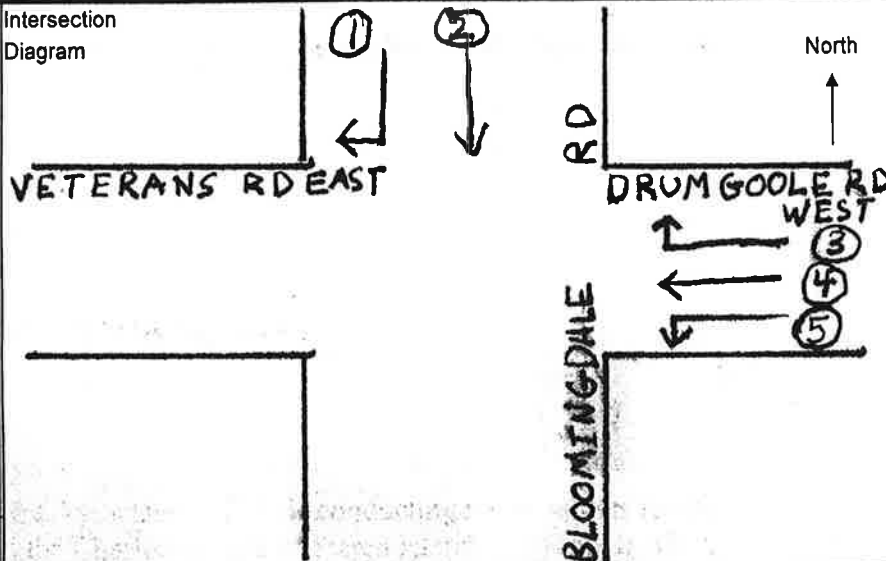
6/11/11

Period: PM

Weather Conditions:

Surveyor's Name:

e: Igor Slavov

[illegible]

Project No.: 1053

Date:

6/8/2011

Period: PM

Weather Conditions:

Surveyor's Name _____

ne YELENA KRAVCHIK

Intersection
Diagram

VETERANS RD

EAST

4 

3 

← 2 ↑ 1

RD

DIRUM GOOLE RD
WEST

BLOOMINGDALE

[illegible]

(212)929-5656

21B

Traffic / Pedestrian Movement Count Sheet

Surveyor's Name

ne. YELENA KRAVCHIK

Intersection Diagram

VETERANS RD

EAST

4 

3 

← 2 ↑ 1

RD

DIRUM GOOLE RD
WEST

North

BLOOMINGDALE

[illegible]

[illegible]

(212)929-5656

21 B

~~Traffic / Pedestrian Movement Count Sheet~~

milege 25

Date:

6/11/11

Period: PM

3pm - 6pm

Weather Conditions:

Surveyor's Name:

MARIANNA KRASIK

Intersection Diagram

VETERANS RD EAST

④

③

△

▽

BLOOMINGDALE

North

DRUMGOOLE
RD WEST

②

① ↑

[illegible]

22 Å

Traffic / Pedestrian Movement Count Sheet

Project No.: 1053

Date: 06/08/11

Period: PM

Weather Conditions:

Surveyor's Name: Grigoriy Gutin

Intersection Diagram

SOUTH SRV RD.

North

DRUMGOOLE RD
EAST

BLOOMINGDALE

[illegible]

(212)929-5656

22A

Traffic / Pedestrian Movement Count Sheet

Intersection
Diagram

06/08/11

Period: PM

Weather Conditions:

Surveyor's Name

Grigoriy Gufin

BLOOMINGTON, IND.

[illegible]

(212)929-5656

22A

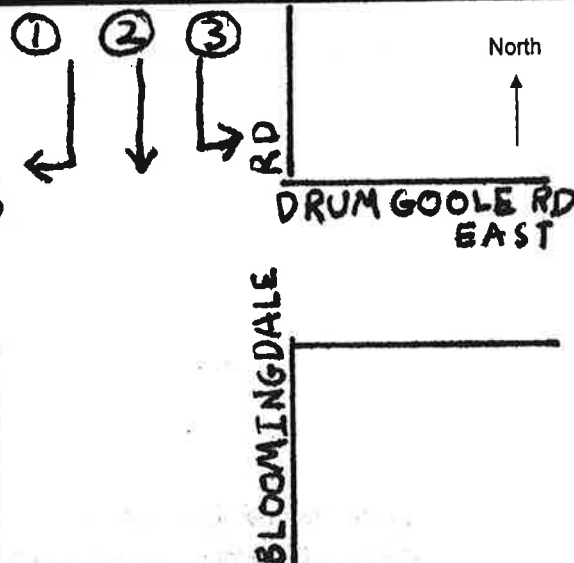
Intersection
Diagram

06/11/11

Period: PM

Weather Conditions: *shower/cloudy*
Tetiana

Surveyor's Name: Benedytska

[illegible]

(212)929-5656

22B

Traffic / Pedestrian Movement Count Sheet

Intersection Diagram

North

Period: PM

Weather Conditions:

Valeria Yampolsky
Surveyor's Name:

SOUTH SRV RD

DR

DRUM GOOLE RD
EAST

BLOOMINGDALE

[illegible]

[illegible]

(212)929-5656

22B

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A

Deiver - 96ml

Intersection Diagram

Date:

06/11/11

Period:

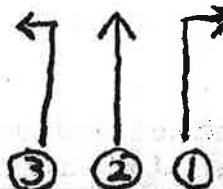
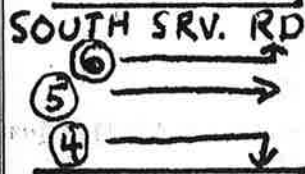
PM

Weather Conditions:

shower / cloudy

Surveyor's Name:

Lioudmila
LAMAKINA



RD

DRUM GOOLE
RD EAST

BLOOMINGDALE

North

[illegible]

23A

Intersection Diagram

Period: 7 PM 9 30

Weather Conditions:

Surveyor's Name:

Inna Sichkan

PLEASANT PLAINS
AVE

AMBOY RD

BLOOMING-DAY

Δ
α

North

4

← 5

6

AMBOY RD

[illegible]

(212)929-5656

 $23\hat{A}$

Traffic / Pedestrian Movement Count Sheet

Date: _____

06/08/11

Period:

1130 PM / 30

Weather Conditions:

Surveyor's Name:

Inna Sishkar

Intersection Diagram

PLEASANT PLAINS
AVE

AMBOY RD

BLOOMINGDALE

△
B

North

4

← 5

$$\sqrt{\quad} 6$$

AMBOY RD

[illegible]

Project No.: 1053

Intersection Diagram

Date:

Period:

Weather Conditions:

Surveyor's Name:

PLEASANT PLAINS
AVE

AMBOY RD

31.00MING-DALE

22

North

↑ 4

← 5

6

AMBOY RD

[illegible]

(212)929-5656

Traffic / Pedestrian Movement Count Sheet

Intersection
Diagram

Period:

1121A

Weather Conditions:

Surveyor's Name:

me: Inna Sichkapa

PLEASANT PLAINS
AVE

AMBOY RD

2100MTNGDALE

RD

North

AMBOY RD

[illegible]

(212)929-5656

(23B)

Traffic / Pedestrian Movement Count Sheet

Intersection Diagram

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

PLEASANT PLAINS
AVE

1. $\uparrow$

 $2 \rightarrow$

3 —

BLOOMINGDALE

2

North

AMBOY RD

AMROY RD

← 4 ↑ 5 ↗ 6

[illegible]

(23B)

[illegible]

Intersection Diagram

PM

Weather Conditions:

Surveyor's Name:

PLEASANT PLAINS
AVE

2 $\longrightarrow$

3 $\rightarrow$

BLOOMINGDALE

10

North

AMBOR RD

ANBOY RD

← ↑ ↗
4 5 6

[illegible]

23B

Project No.: 1121A

Date:

Period: PM

Weather Conditions:

Surveyor's Name:

Intersection Diagram

PLEASANT PLAINS

AVE ↑

2 →

3

AMBOY RD

← 4 ↑ 5 ↗ 6

RICOMTANGDALE

RD

North

AMBOY RD

501 FLOOD AVE

[illegible]

[illegible]

(212)929-5656

23C

Traffic / Pedestrian Movement Count Sheet

Intersection Diagram

PLEASANT PLAINS
AVE

Period: PM

Weather Conditions:

Michael
Shapiro

Surveyor's Name:

HV - Count Vehicles
w/ more than 4
wheels
(Heavy Vehicles)

ANBOY RD

$\leftarrow$ $\uparrow$ $\rightarrow$
 9HV 8HV 7HV

			Movements											
Time			1	2	3	4	5	6	7	8	9	10	11	12
11:30	to	11:45	—	4	2	1	—	1	—	—				
11:45	to	12:00	—	4	2	4	3	—	2	2				
12:00	to	12:15	—	—	1	2	2	—	2	4				
12:15	to	12:30	—	—	2	—	4	1	3	2				
12:30	to	12:45	—	—	2	1	3	—	5	2				
12:45	to	13:00	—	—	—	1	4	1	2	—				
13:00	to	13:15	—	—	—	1	1	—	6	—				
13:15	to	13:30	—	1	—	3	—	—	2	1				
Peak Hour										7		1		

(23C)

Project No.: 1053

Date: 06/08/11

Period: PM

Weather Conditions:

Surveyor's Name:

Michael
Shapiro

Intersection
Diagram

PLEASANT PLAINS
AVE

HV - Count Vehicles
w/ more than 4
wheels
(Heavy Vehicles)

1HV 2HV 3HV

BLOOMING-DALE

22

North

AMBOY RD

↑ 4HV

← 5HV

6 HV

AMBOY RD

$\leftarrow$ $\uparrow$ $\rightarrow$
 $9HV$ $8HV$ $7HV$

[illegible]

226, W. 26th St. 9FL
New York, NY 10001
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23C

Project No.: 1121A

Date:

Q'6/11/11

Period: PM

PM

driver

Weather Conditions:

Michael

Surveyor's Name:

Shapino

Intersection Diagram

PLEASANT PLAINS
AVE

HV - Count vehicles
w/ more than 4
wheels
(Heavy Vehicles)

1 HV 2HV 3HV

BLOOMING DALE

ANBOY RD

4 HV

5 HV

6 HV

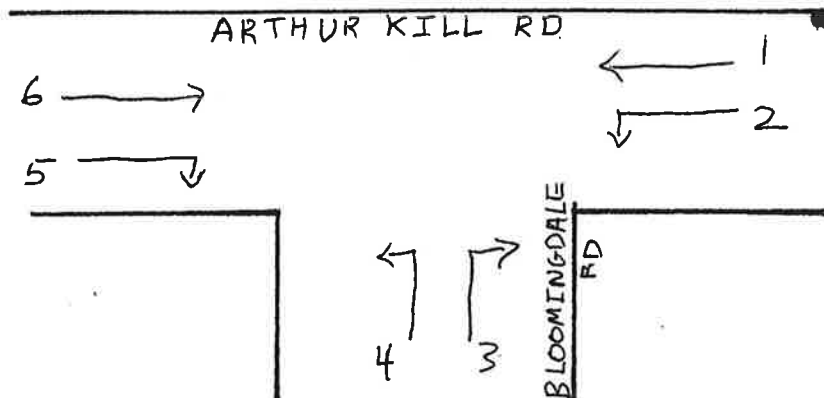
North

AMBOY RD

$\leftarrow$ $\uparrow$ $\rightarrow$
 9HV 8HV 7HV

[illegible]

North

[illegible]

[illegible]

Traffic / Pedestrian Movement Count Sheet

Project No.: 1053

Intersection Diagram

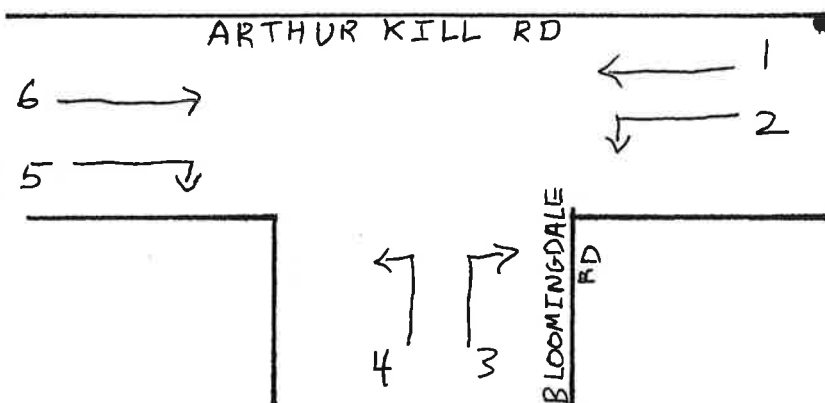
North

Date:

Period: PM

Weather Conditions:

Surveyor's Name: Olga Klimenko

[illegible]

(212)929-5656

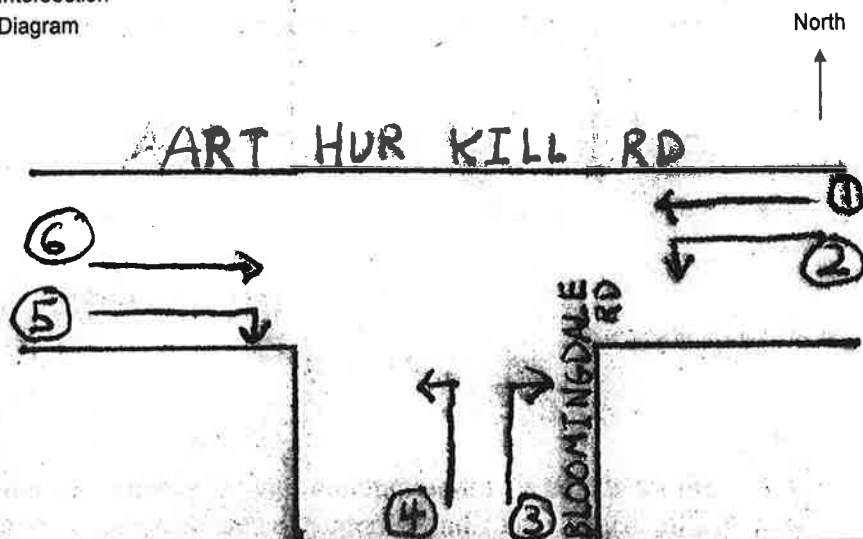
24

6.11.11

PM

Weather Conditions: *Dm: tri:Y Kobtsev*

Surveyor's Name:

[illegible]

VC1

Project N 1121A
Location:

Date: 6/7/2011

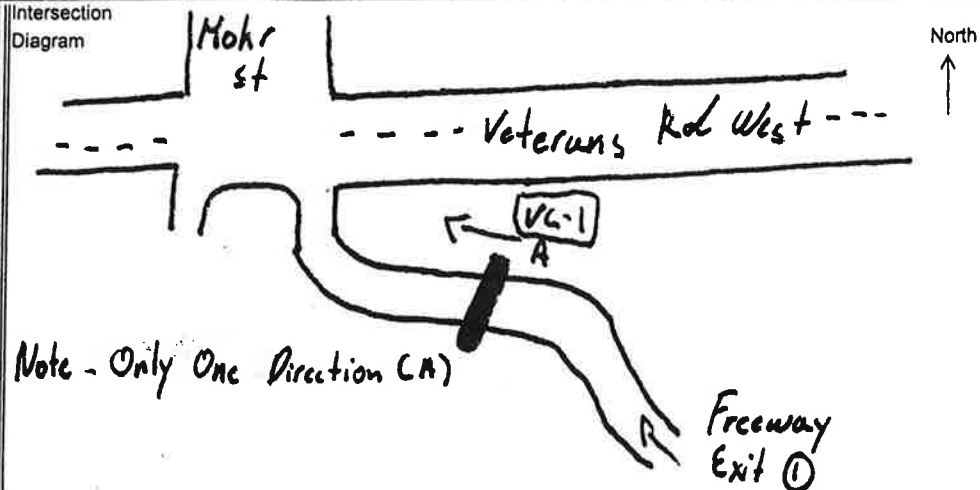
Period: 4:40 AM

Stanislaw
Filer

Weather Conditions:

Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	91	1	2	1	8	42						
7:45 to 8:00	92	4	1	1	2	38						
8:00 to 8:15	85	7	-	-	12	33						
8:15 to 8:30	73	7	1	1	8	32						
8:30 to 8:45	79	6	1	-	10	28						
8:45 to 9:00	83	5	-	-	5	26						
9:00 to 9:15	78	9	2	-	11	27						
9:15 to 9:30	66	2	1	1	13	21						
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
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VC1

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

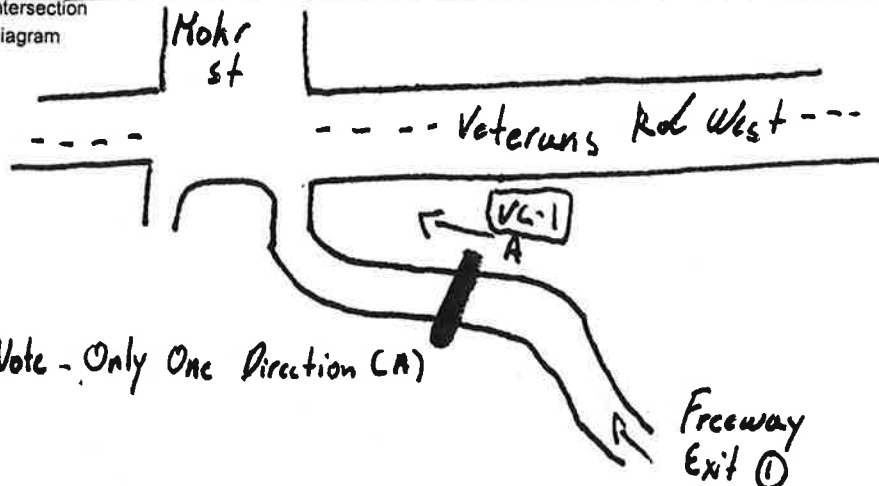
Date: 6/7/2011

Period: MD

Weather Conditions:

Stanislar
Surveyor's Name: Filer

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	92	11	2	-	4	26						
11:45 to 12:00	88	6	1	1	4	39						
12:00 to 12:15	105	3	1	2	5	28						
12:15 to 12:30	99	4	4	-	3	23						
12:30 to 12:45	81	1	1	2	1	34						
12:45 to 13:00	82	5	1	2	1	31						
13:00 to 13:15	75	2	-	-	1	40						
13:15 to 13:30	102	3	3	1	1	36						
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
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VC-1

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Date: 6/7/2011

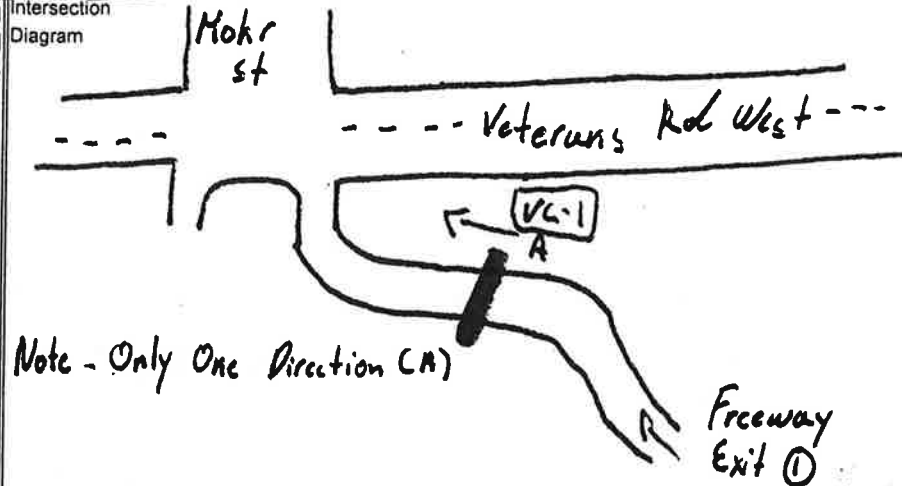
Period: PM

STANISLAV
FILEV

Weather Conditions:

Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	106	3	3	1	2	36						
16:45 to 17:00	98	1	1	1	1	60						
17:00 to 17:15	115	2	3	1	1	67						
17:15 to 17:30	111	1	1	0	2	58						
17:30 to 17:45	114	3	1	-	3	64						
17:45 to 18:00	115	1	-	5	2	55						
18:00 to 18:15	112	2	-	-	3	54						
18:15 to 18:30	111	2	1	-	2	52						
Hour												

uty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
uty Trucks (6 or more Wheels; Walk-In Trucks)
rucks (with Vertical Tale Pipe; Tractor-Trailers)

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VC 1

Traffic / Pedestrian Movement Count Sheet

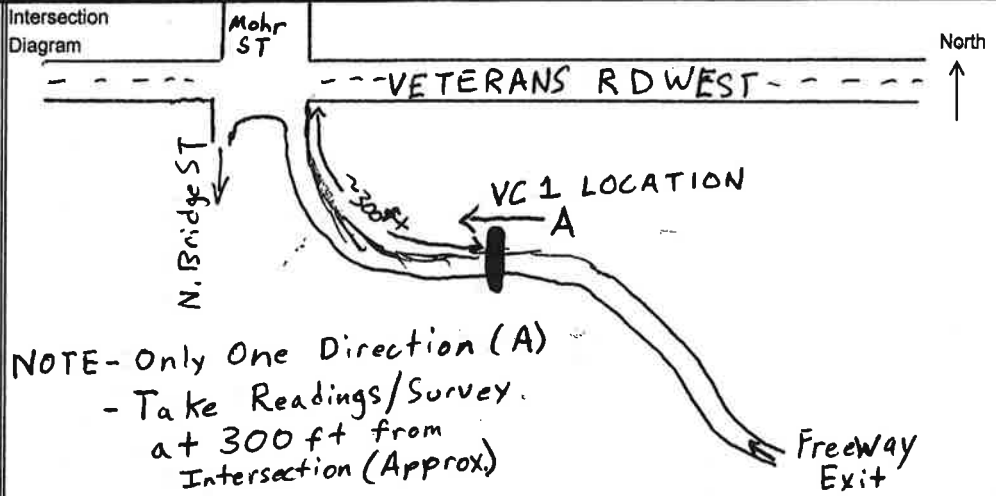
Project No.: 1121A
Location: EXIT ONE OFF RICHMOND PKWY

Date: Jun-4-2011

Period:

Weather Conditions:

Surveyor's Name: STANISLAV FILEV



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	121	2	-	-	2	35						
3:15 to 3:30	112	2	-	-	-	44						
3:30 to 3:45	114	2	-	-	1	81						
3:45 to 4:00	151	2	1	-	-	32						
4:00 to 4:15	114	-	-	-	2	44						
4:15 to 4:30	117	-	-	1	-	27						
4:30 to 4:45	134	2	-	-	-	25						
4:45 to 5:00	122	2	-	-	1	33						
5:00 to 5:15	113	9	-	-	-	28						
5:15 to 5:30	124	2	-	-	2	31						
5:30 to 5:45	123	1	-	-	1	43						
5:45 to 6:00	119	1	-	-	1	45						
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
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VC-2

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Date:

Period: **mid AM**

Weather Conditions:

Surveyor's Name: **Rafiyg Brydantseva**

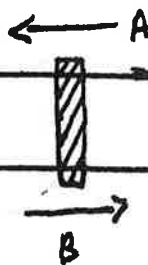
Intersection
Diagram

Mohr St

VETERANS
RD WEST

Tyrellan Ave

North
↑



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	92	7	1	3	6	4	33	3	1	-	2	1
7:45 to 8:00	106	13	4	2	5	5	48	7	3	2	-	2
8:00 to 8:15	103	7	6	5	3	-	50	9	5	3	1	1
8:15 to 8:30	95	15	2	2	5	-	56	5	1	-	-	-
8:30 to 8:45	107	11	1	3	4	6	59	6	4	1	4	5
8:45 to 9:00	86	10	-	3	2	10	28	7	1	-	-	7
9:00 to 9:15	60	13	7	4	5	15	22	5	2	-	-	13
9:15 to 9:30	74	12	2	3	5	13	29	6	2	-	2	11
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

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VL-2

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

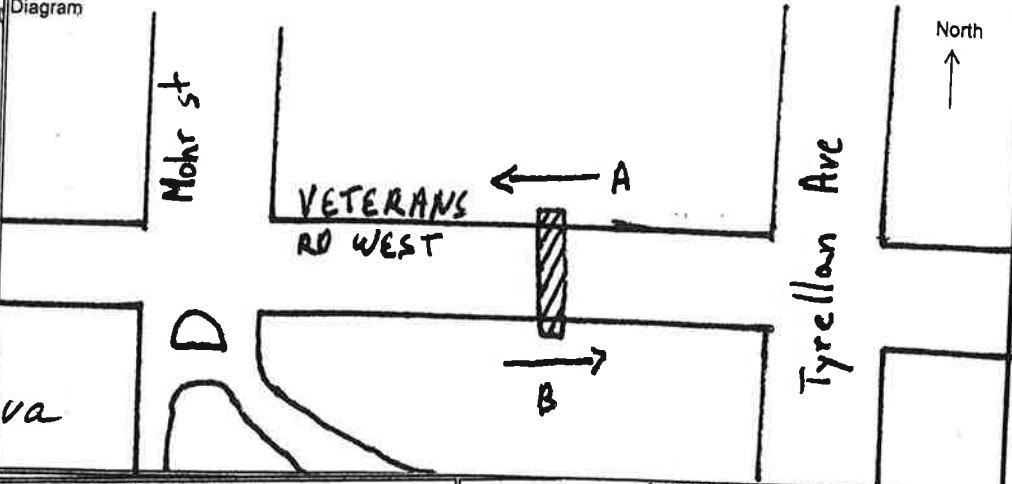
Date:

Period: MD

Weather Conditions:

Rafiya Budantseva
Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	87	12	2	4	2	6	59	8	1	-	-	3
11:45 to 12:00	113	12	4	1	2	7	59	8	3	1	-	4
12:00 to 12:15	125	13	5	2	3	8	62	9	1	1	-	3
12:15 to 12:30	103	8	7	2	2	9	66	4	1	-	-	5
12:30 to 12:45	109	11	2	1	3	7	78	12	2	-	-	3
12:45 to 13:00	109	10	5	2	1	1	92	6	1	1	-	2
13:00 to 13:15	102	5	2	2	2	2	73	8	1	1	-	1
13:15 to 13:30	96	5	4	3	2	6	74	5	1	1	1	4
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-in Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

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226, W: 26th St. 9FL

New York, NY 10001

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VC-2

Traffic / Pedestrian Movement Count Sheet

Project N 1121A

Location :

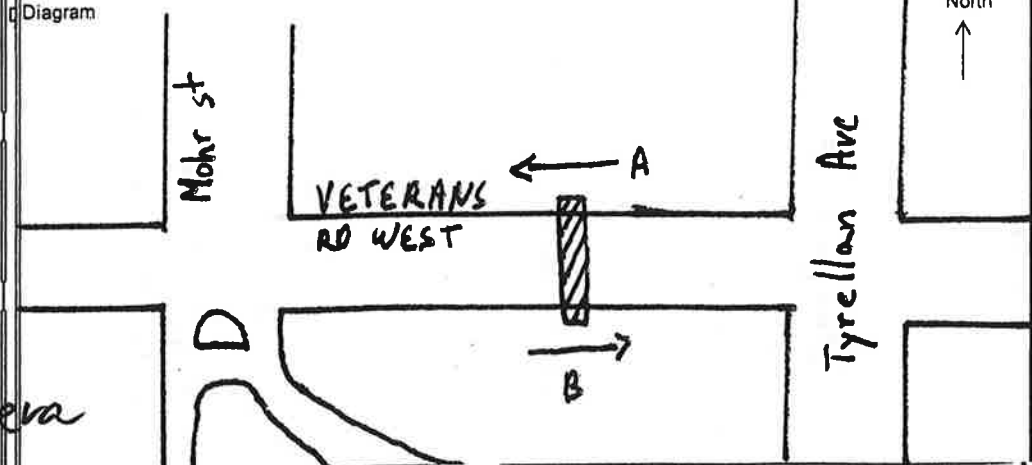
Intersection
Diagram

Date:

Period: PM

Weather Conditions:

Rafiya Budantseva
Surveyor's Name:



Time			Location/Direction A						Location/Direction B					
			AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30	to	16:45	126	16	3	1	4	1	83	7	2	1	-	-
16:45	to	17:00	97	14	2	1	4	2	52	3	-	-	-	1
17:00	to	17:15	104	4	3	1	5	2	75	6	-	-	-	1
17:15	to	17:30	100	12	-	-	7	4	77	4	-	-	-	-
17:30	to	17:45	125	5	5	1	4	2	70	4	1	-	1	-
17:45	to	18:00	113	7	4	1	4	-	68	5	1	-	1	-
18:00	to	18:15	82	6	-	2	8	1	75	2	2	-	1	-
18:15	to	18:30	91	11	1	-	8	-	69	7	-	-	1	1
Peak Hour														

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)

HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)

DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

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326, W. 26th St. 9FL

New York, NY 10001

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VC 2

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A

Location:
VETERANS RD W Between
MOHR and TYRELLAN

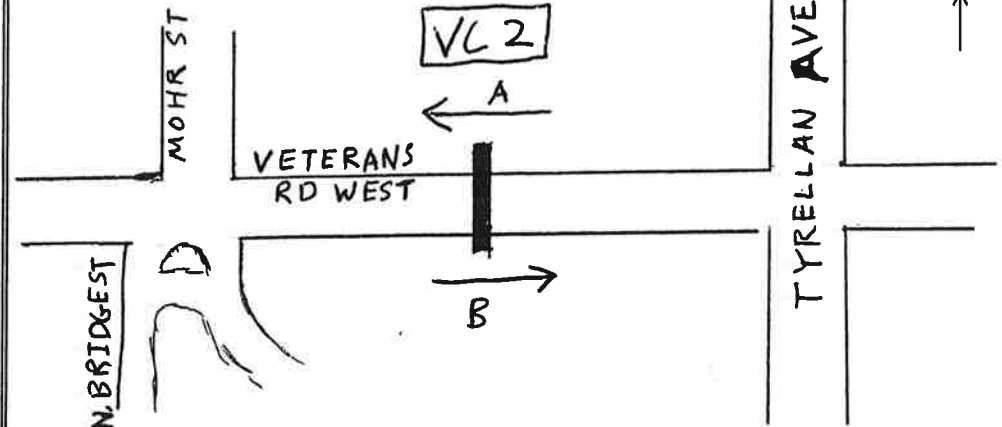
Date:
June- 4-2011

Period:

Weather Conditions:

Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	84	5	—	—	—	67	64	7	—	—	—	33
3:15 to 3:30	53	7	1	—	3	48	46	3	+	—	—	25
3:30 to 3:45	73	13	1	—	3	38	37	7	1	—	—	26
3:45 to 4:00	57	11	1	—	4	42	47	4	1	—	—	28
4:00 to 4:15	61	9	1	—	2	37	55	3	+	—	1	22
4:15 to 4:30	55	6	1	1	2	40	51	1	+	1	—	30
4:30 to 4:45	63	10	—	1	—	37	59	1	—	+	—	43
4:45 to 5:00	37	4	—	1	3	35	26	2	—	—	—	29
5:00 to 5:15	23	1	—	—	—	12	44	2	1	1	2	26
5:15 to 5:30	38	—	1	—	—	26	32	1	1	—	2	23
5:30 to 5:45	43	2	—	—	1	12	41	6	2	—	—	23
5:45 to 6:00	38	2	1	—	—	24	50	9	—	—	2	34
Peak Hour	3:00	3:30	—	—	4:45	3:00	4:30	5:45	—	—	—	4:30

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)

HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)

DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

VC-3

Project N 1121A
Location:

Intersection
Diagram

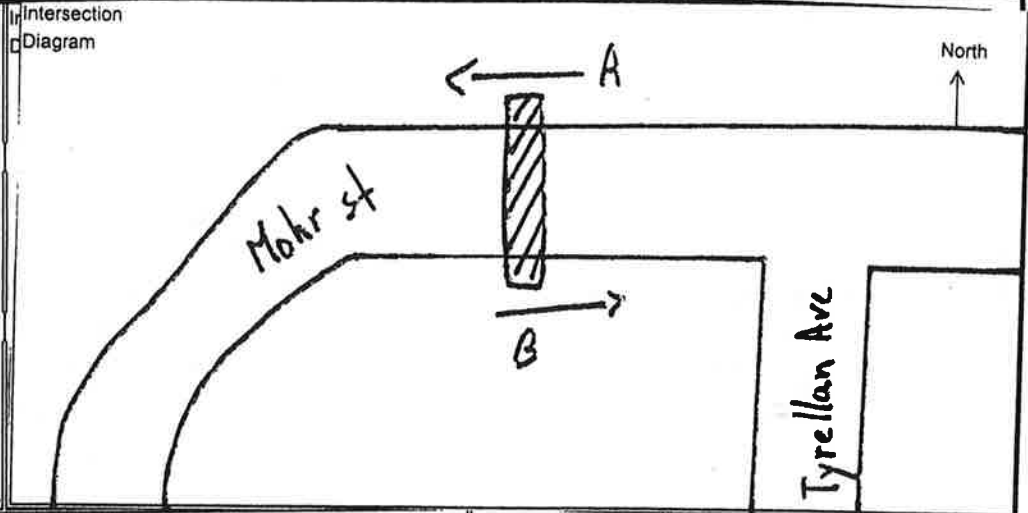
Date:

Jun 7 2011

Period: ~~MD~~ AM

Weather Conditions:

Surveyor's Name: *Valentina Yermakova*



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	2	—	—	—	—	—	8	5	1	—	2	2
7:45 to 8:00	13	—	—	—	—	1	9	2	—	—	1	4
8:00 to 8:15	15	2	—	—	—	3	8	1	—	—	3	—
8:15 to 8:30	6	1	—	1	—	1	11	1	—	—	2	2
8:30 to 8:45	7	1	—	—	—	5	19	1	1	—	2	5
8:45 to 9:00	11	2	1	—	—	3	9	1	—	—	—	6
9:00 to 9:15	6	1	1	1	—	2	10	—	—	—	2	2
9:15 to 9:30	13	—	—	—	—	5	17	2	—	—	5	6
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

VC-3

Project N 1121A
Location :

Intersection
Diagram

Date:

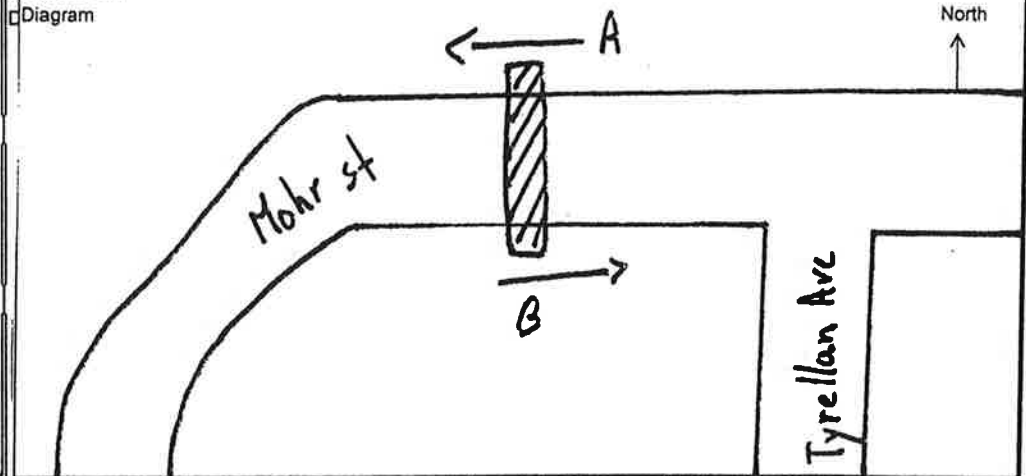
06/07/2011

Period: MD

Weather Conditions:

Surveyor's Name:

Valentina Yermakova



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	15	1	-	-	-	7	19	4	-	-	2	5
11:45 to 12:00	21	1	1	-	1	6	34	2	1	-	1	8
12:00 to 12:15	17	3	-	1	-	4	24	3	-	-	1	11
12:15 to 12:30	38	-	-	-	-	6	18	1	-	-	3	8
12:30 to 12:45	25	2	-	-	-	9	18	-	1	1	2	6
12:45 to 13:00	17	-	-	1	-	5	24	2	-	-	1	12
13:00 to 13:15	22	-	2	-	-	9	31	1	1	-	2	10
13:15 to 13:30	26	-	-	-	-	8	25	1	1	-	-	11
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

VC-3

Project N 1121A
Location:

Intersection
Diagram

Date:

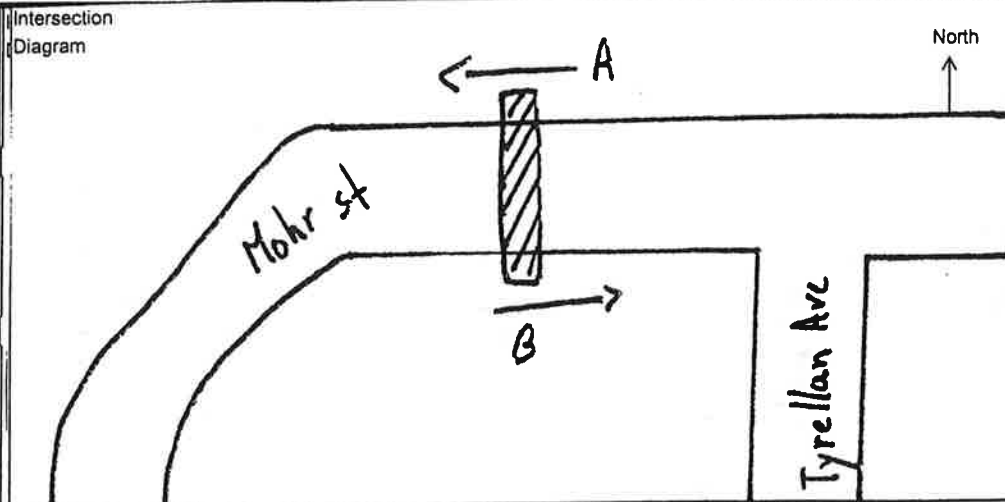
06/07/11

Period: PM

Weather Conditions:

Surveyor's Name:

Valeriy Yermakova



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	24	-	-	-	-	3	20	2	-	-	4	8
16:45 to 17:00	16	6	-	-	-	6	16	-	-	-	2	6
17:00 to 17:15	31	1	-	-	1	6	24	-	-	-	3	10
17:15 to 17:30	20	1	-	-	-	6	23	2	-	-	1	12
17:30 to 17:45	21	-	-	-	-	12	14	-	-	-	1	7
17:45 to 18:00	16	-	-	-	-	8	18	1	-	-	2	9
18:00 to 18:15	21	-	-	-	-	10	17	-	1	-	2	7
18:15 to 18:30	29	-	2	-	-	5	24	2	-	-	3	10
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trallers)

VC 3

Project No.: 1121A
Location: MOHR ST between
TYRELLAN and VETERANS
RD WEST

Date:

Jun 4 2011

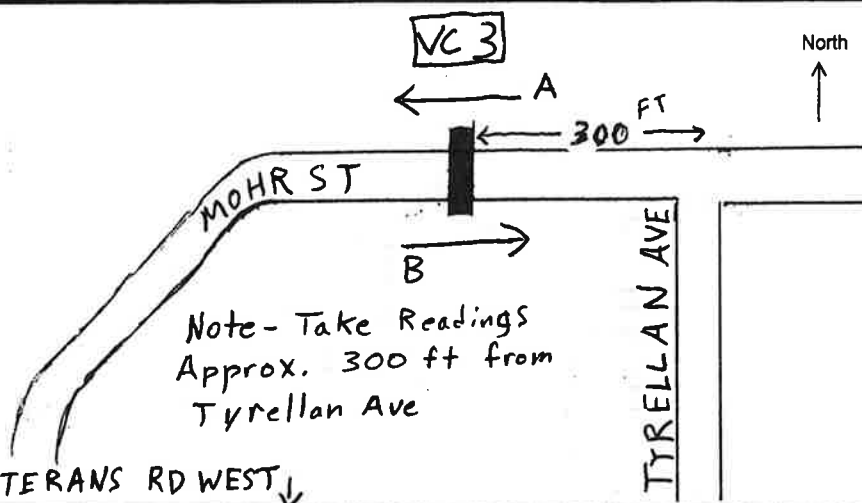
Period:

Weather Conditions:

Surveyor's Name:

Valentina Yermakova

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	36	4	—	—	—	2	56	2	—	—	1	6
3:15 to 3:30	36	2	1	—	—	2	63	1	—	—	2	4
3:30 to 3:45	33	—	—	—	—	2	47	1	1	—	1	2
3:45 to 4:00	52	3	—	—	—	—	51	1	—	—	3	1
4:00 to 4:15	38	2	—	—	—	—	40	—	—	—	1	—
4:15 to 4:30	36	4	—	—	—	1	36	1	—	—	2	3
4:30 to 4:45	27	6	—	—	—	1	43	2	—	—	—	1
4:45 to 5:00	31	1	1	—	—	1	40	—	—	—	2	2
5:00 to 5:15	30	—	—	—	—	—	34	1	—	—	1	4
5:15 to 5:30	21	1	—	—	—	—	33	—	—	—	2	4
5:30 to 5:45	23	—	—	1	—	2	46	1	—	—	1	2
5:45 to 6:00	36	—	—	—	—	2	37	—	—	—	1	3
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

VC 4

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

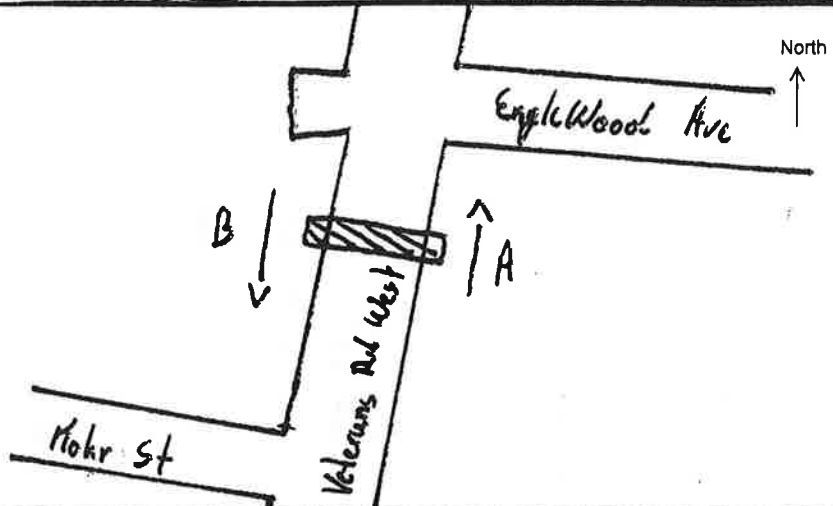
Intersection
Diagram

Date: 06/07/2011

Period: MD AM

Weather Conditions:

Surveyor's Name: YURIY MILEV



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	21	4	-	-	1	1	83	5	3	-	3	14
7:45 to 8:00	25	-	-	-	3	3	96	4	1	-	1	13
8:00 to 8:15	33	1	-	-	-	2	89	2	2	-	3	25
8:15 to 8:30	43	-	-	-	-	4	95	9	2	1	3	16
8:30 to 8:45	36	2	-	1	-	3	118	5	1	-	1	21
8:45 to 9:00	32	4	-	-	-	2	107	2	-	-	1	16
9:00 to 9:15	40	3	-	-	-	4	93	4	3	1	1	16
9:15 to 9:30	31	2	-	1	-	3	121	5	1	-	3	14
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-in Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
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VC-4

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Intersection
Diagram

Date:

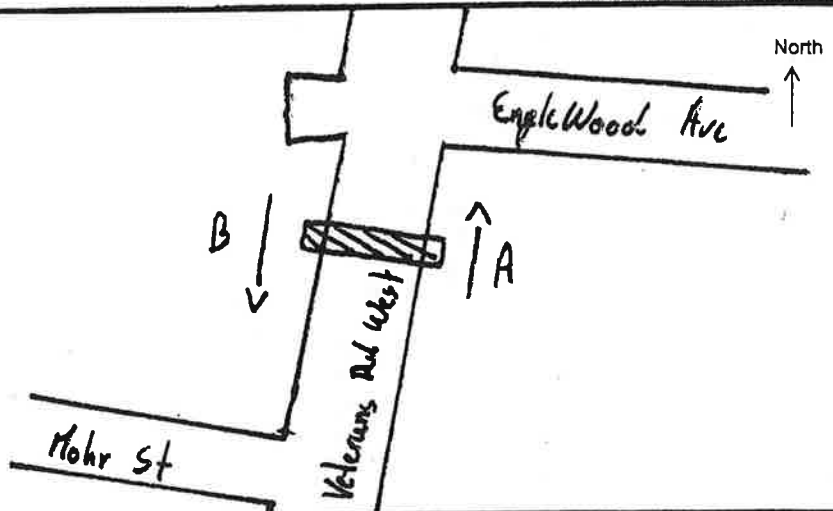
06/07/2011

Period: MD

Weather Conditions:

Surveyor's Name:

YUAIY MALAY



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	62	10	-	-	1	9	120	5	-	-	1	23
11:45 to 12:00	71	2	-	-	1	4	160	5	3	-	2	24
12:00 to 12:15	62	3	-	-	2	4	172	9	2	-	4	17
12:15 to 12:30	77	3	-	-	-	5	146	4	2	-	-	31
12:30 to 12:45	74	3	-	-	-	7	148	9	2	1	1	25
12:45 to 13:00	79	2	-	-	-	3	126	5	-	-	-	15
13:00 to 13:15	86	3	-	-	-	7	122	4	1	-	2	18
13:15 to 13:30	80	4	-	1	1	7	109	6	-	-	1	24
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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VC-4

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location :

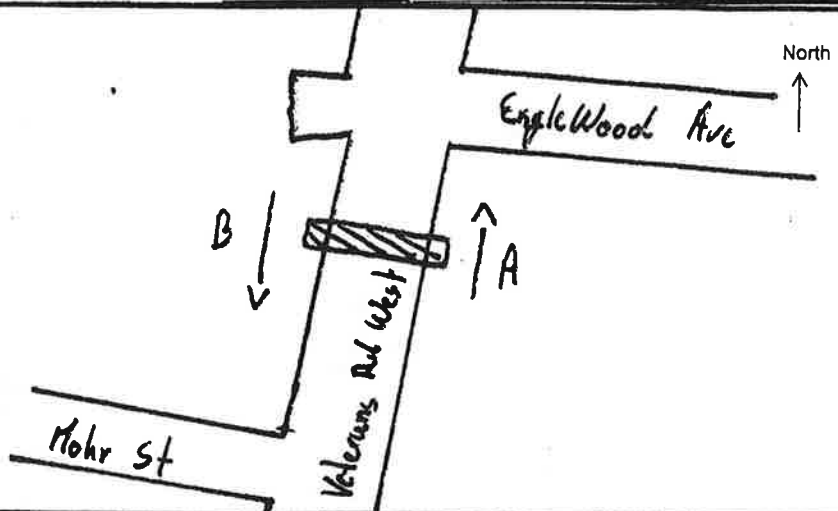
Date: 06/07/2011

Period: PM

Weather Conditions:

Surveyor's Name: YURIY MALEY

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	69	1	-	-	-	7	127	4	-	-	2	10
16:45 to 17:00	68	2	-	-	-	11	157	14	-	-	2	14
17:00 to 17:15	74	-	-	-	1	19	117	3	-	1	2	18
17:15 to 17:30	63	-	-	-	-	18	126	5	-	-	3	15
17:30 to 17:45	65	1	-	-	-	11	124	7	1	-	4	12
17:45 to 18:00	62	2	-	-	-	14	135	8	-	-	1	12
18:00 to 18:15	74	4	-	-	1	14	130	2	-	-	7	9
18:15 to 18:30	60	-	-	-	-	15	119	2	-	-	4	11
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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VC 4

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A
Location: VETERANS RDW between MOHR and ENGLEWOOD

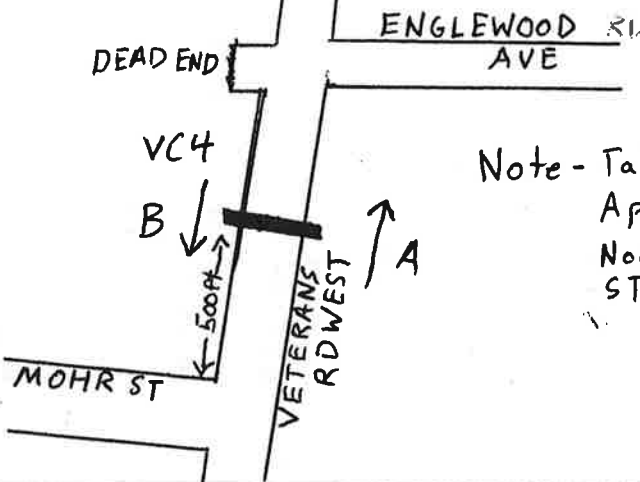
Date: June 04, 2011

Period:

Weather Conditions:

Surveyor's Name: Yurii Malev

Intersection Diagram



Note - Take Readings
Approx. 500ft
North of Mohr
ST.

Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	86	-	-	-	-	8	113	4	-	-	-	16
3:15 to 3:30	105	-	-	-	-	5	138	2	-	-	-	32
3:30 to 3:45	93	2	-	-	-	9	150	5	-	-	3	40
3:45 to 4:00	99	-	-	-	-	14	170	7	-	-	1	35
4:00 to 4:15	109	-	-	-	-	16	161	5	-	-	1	30
4:15 to 4:30	102	1	-	-	-	7	132	5	-	-	-	24
4:30 to 4:45	110	2	-	-	-	10	123	8	-	-	-	17
4:45 to 5:00	93	-	-	-	-	9	147	4	-	-	-	28
5:00 to 5:15	91	-	-	-	-	7	139	2	-	-	-	21
5:15 to 5:30	82	-	-	-	-	6	145	4	-	-	-	14
5:30 to 5:45	78	-	-	-	-	6	130	3	-	-	-	27
5:45 to 6:00	80	-	-	-	-	7	122	2	-	-	-	33
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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VC 5

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Date:

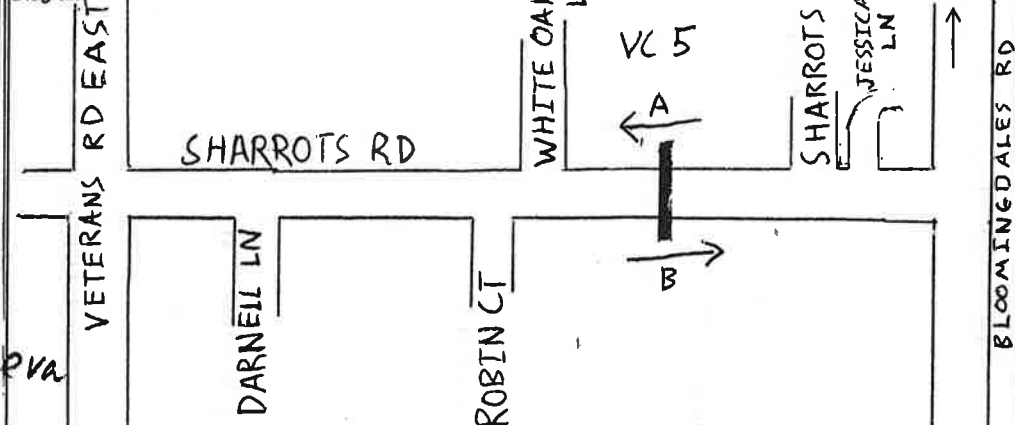
Period: AM

Weather Conditions: sunney

Rafiya Budantseva

Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	17	2	-	-	2	2	23	4	2	-	1	3
7:45 to 8:00	15	1	1	-	5	1	27	6	2	-	2	4
8:00 to 8:15	20	2	-	-	1	-	20	3	4	-	2	1
8:15 to 8:30	13	3	-	1	2	4	29	3	-	-	1	4
8:30 to 8:45	14	2	2	-	1	-	20	2	1	-	2	1
8:45 to 9:00	24	3	-	-	-	2	15	3	3	-	-	-
9:00 to 9:15	10	3	1	-	-	-	14	2	2	-	-	2
9:15 to 9:30	15	2	3	-	-	1	14	6	1	-	-	2
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-in Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

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VC-5

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location :

Date:

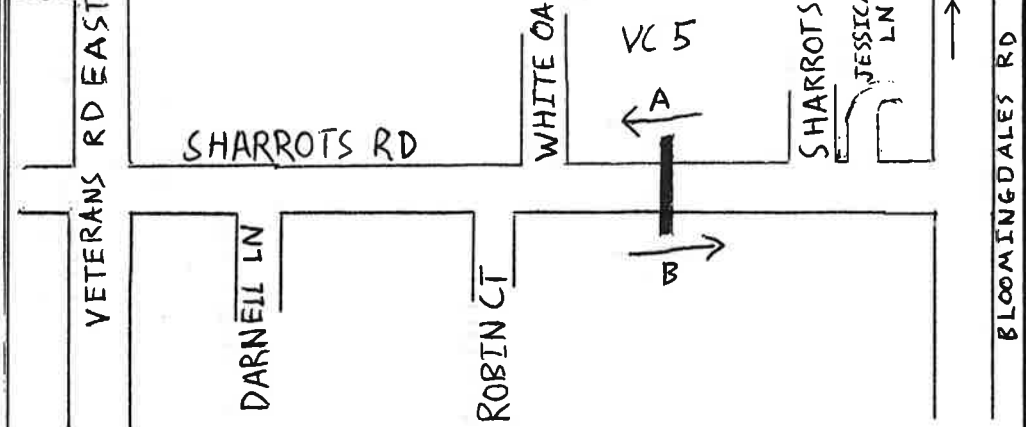
Period: MD

Weather Conditions: *SUNNY*

Rafiq Budantseva

Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	21	-	-	-	-	3	19	3	3	-	-	1
11:45 to 12:00	24	3	-	-	1	-	16	2	1	-	-	1
12:00 to 12:15	14	5	-	-	-	2	18	3	1	1	1	-
12:15 to 12:30	20	2	-	1	-	-	18	-	-	-	-	2
12:30 to 12:45	17	1	1	-	-	2	21	1	-	-	-	3
12:45 to 13:00	14	1	2	-	-	5	17	1	-	1	-	5
13:00 to 13:15	18	3	2	-	-	-	26	1	-	-	1	-
13:15 to 13:30	9	3	-	-	1	2	16	4	1	-	1	1
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

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New York, NY 10001
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VC-5

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

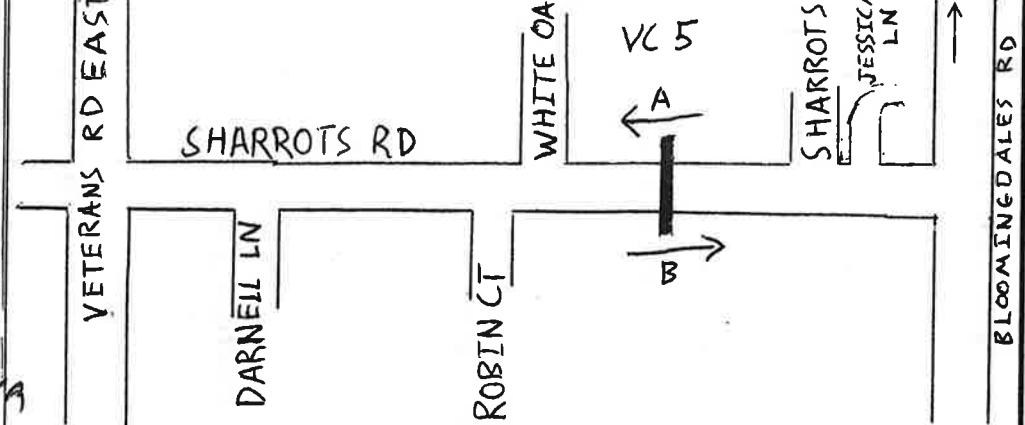
Date:

Period: PM

Weather Conditions:

Rafiya Budantseva
Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	16	3	2	—	—	1	24	2	—	—	—	2
16:45 to 17:00	37	1	—	—	—	9	42	3	—	—	—	9
17:00 to 17:15	24	1	1	—	—	2	32	3	2	—	—	4
17:15 to 17:30	42	5	—	—	1	3	36	1	—	—	—	6
17:30 to 17:45	37	1	4	1	1	5	35	3	—	—	—	8
17:45 to 18:00	19	4	—	—	—	6	24	4	—	—	—	2
18:00 to 18:15	37	1	—	1	—	6	33	1	1	—	—	2
18:15 to 18:30	32	4	3	1	1	5	26	5	—	—	—	1
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

VC-5

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A
Location:

Date:

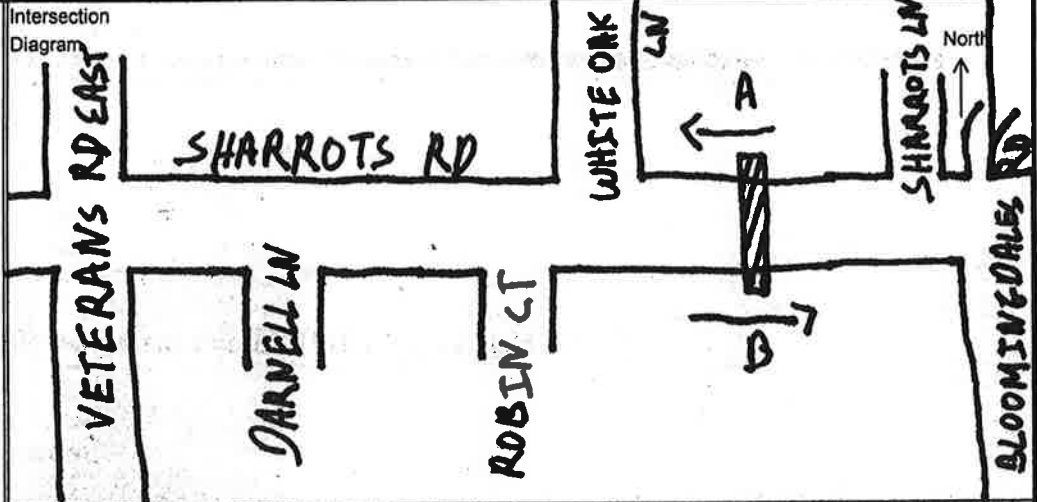
Period:

Weather Conditions:

Surveyor's Name:

Rafiya
Bydantseva

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	27	1	-	-	-	-	29	1	-	-	-	1
3:15 to 3:30	23	2	1	-	-	6	27	3	-	-	-	6
3:30 to 3:45	24	-	2	-	-	7	24	-	-	-	-	2
3:45 to 4:00	23	3	1	-	-	7	27	2	-	-	-	6
4:00 to 4:15	22	2	-	-	-	4	20	1	-	-	-	2
4:15 to 4:30	21	1	-	-	-	2	29	3	-	-	-	3
4:30 to 4:45	25	-	-	-	-	8	24	2	3	-	-	7
4:45 to 5:00	21	2	-	-	-	7	25	2	1	-	-	7
5:00 to 5:15	24	4	1	-	-	3	27	3	-	-	-	5
5:15 to 5:30	22	1	1	-	-	7	18	3	1	-	-	10
5:30 to 5:45	27	1	-	-	-	6	13	2	-	-	-	5
5:45 to 6:00	26	1	-	-	-	7	24	1	-	-	-	5
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-in Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
(212)929-5656

VC6

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Intersection
Diagram

Date:

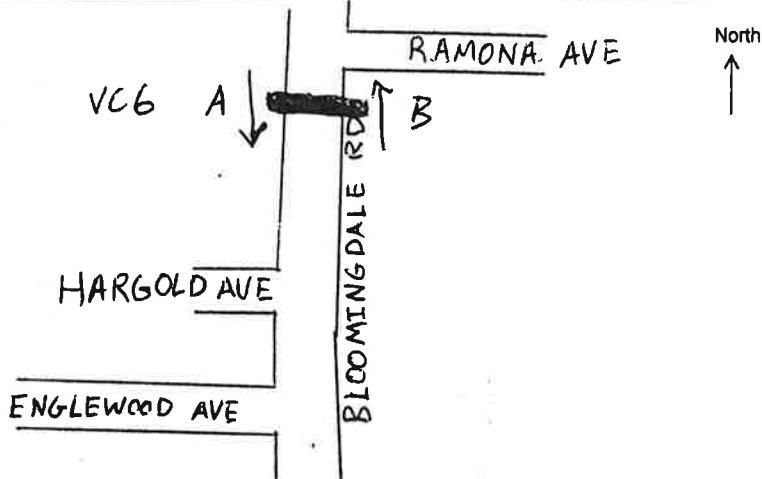
Period: AM

6/8/11

Weather Conditions:

Stanislav
Filer

Surveyor's Name:



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	60	4	2	-	4	16	49	3	-	-	6	9
7:45 to 8:00	63	5	2	-	4	17	51	4	-	-	5	11
8:00 to 8:15	69	7	2	-	5	19	58	5	-	1	6	17
8:15 to 8:30	81	3	1	-	4	11	77	2	1	-	9	12
8:30 to 8:45	56	4	4	-	6	20	53	-	1	-	3	23
8:45 to 9:00	53	2	2	-	7	7	68	2	1	-	1	5
9:00 to 9:15	51	8	-	-	2	8	57	6	-	-	3	7
9:15 to 9:30	61	5	2	-	-	9	50	3	1	-	4	6
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

PHILIP HABIB & ASSOCIATE
226, W. 26th St. 9FL
New York, NY 10001
(212)929-5656

VC-6

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location :

Intersection
Diagram

Date:

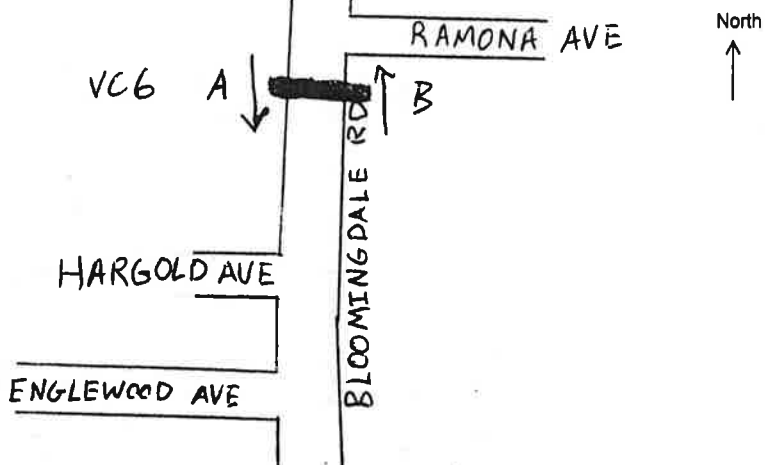
Period: MD

6/8/11

Weather Conditions:

Stanislav
Filer

Surveyor's Name:



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	56	4	1	-	2	5	53	2	-	-	-	13
11:45 to 12:00	54	4	1	-	2	7	68	2	2	-	3	6
12:00 to 12:15	57	1	1	-	2	9	60	4	1	-	2	10
12:15 to 12:30	56	1	-	-	-	10	51	1	1	-	1	11
12:30 to 12:45	59	1	-	-	1	9	52	1	-	-	-	12
12:45 to 13:00	73	3	-	-	1	10	66	3	-	-	1	9
13:00 to 13:15	57	-	1	-	3	10	68	-	-	-	2	17
13:15 to 13:30	75	3	3	-	1	9	67	2	1	-	2	12
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
(212)929-5656

VC-6

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Intersection
Diagram

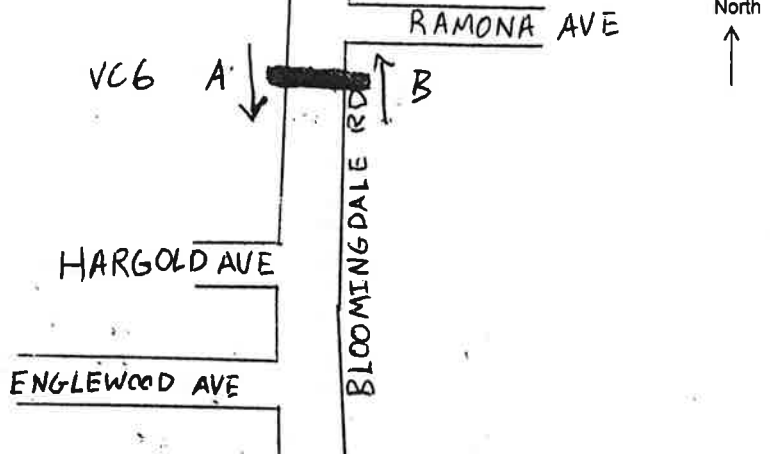
Date: 6/8/11

Period: PM

Stanislav
Filer

Weather Conditions:

Surveyor's Name:



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	66	1	1	1	-	15	79	-	2	-	1	12
16:45 to 17:00	97	2	1	-	1	13	73	1	-	-	1	16
17:00 to 17:15	104	2	2	-	2	11	99	3	-	-	-	15
17:15 to 17:30	84	-	-	-	13	13	96	-	-	-	1	11
17:30 to 17:45	113	2	-	-	5	5	82	-	-	-	-	6
17:45 to 18:00	89	-	1	-	1	3	79	3	1	-	-	2
18:00 to 18:15	103	1	-	-	2	2	91	2	-	-	1	1
18:15 to 18:30	91	1	-	-	1	3	88	1	-	-	2	1
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

HABIB & ASSOCIATES
 W. 26th St. 9FL
 New York, NY 10001
 (212) 929-5656

VL6

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A
 Location:

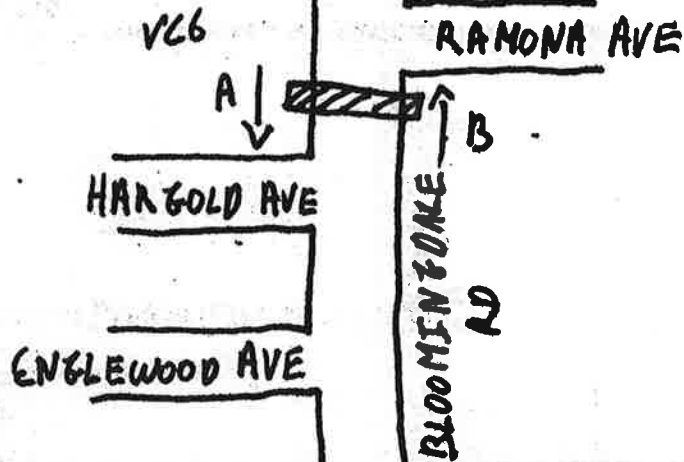
Intersection
 Diagram

Date: 6/11/2011

Period:
 STANISLAV
 FILEV

Weather Conditions:

Surveyor's Name:



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	55	-	-	-	-	28	74	-	-	-	-	29
3:15 to 3:30	44	-	-	-	-	26	46	-	1	-	-	43
3:30 to 3:45	54	1	-	-	-	20	60	-	1	-	-	17
3:45 to 4:00	52	-	-	-	-	33	53	1	-	-	-	34
4:00 to 4:15	50	1	-	-	-	35	67	-	1	-	-	31
4:15 to 4:30	47	1	-	-	-	26	66	-	-	-	-	27
4:30 to 4:45	48	5	-	-	-	29	47	-	1	-	-	19
4:45 to 5:00	45	-	-	-	-	22	48	2	1	-	-	24
5:00 to 5:15	44	-	1	-	1	31	49	-	-	-	-	18
5:15 to 5:30	50	-	-	-	-	32	51	1	-	-	-	20
5:30 to 5:45	53	1	-	-	-	21	67	1	-	-	-	21
5:45 to 6:00	56	-	-	-	-	24	61	-	-	-	-	23
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
 HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
 DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

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New York, NY 10001
(212)929-5656

VC7

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

Date:

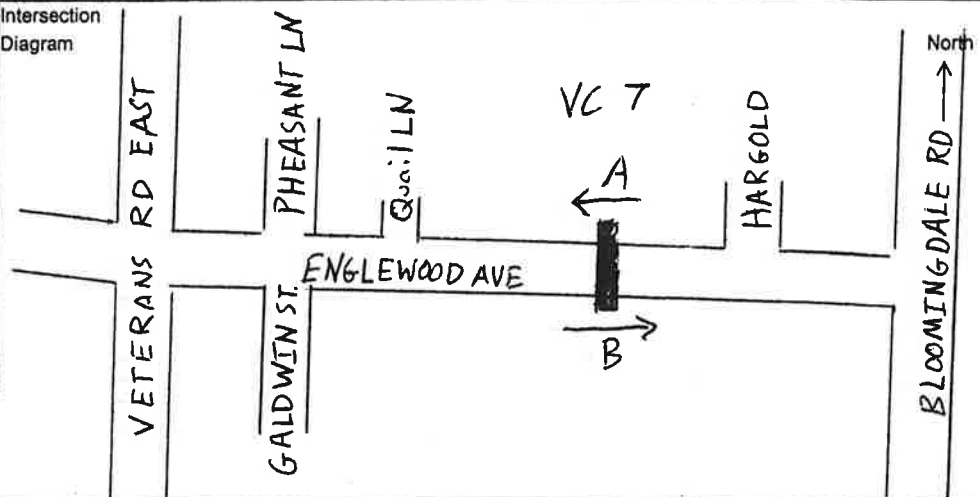
06/08/11

Period: AM

Weather Conditions: Sunny

Surveyor's Name: Valentyna Yermakova

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
7:30 to 7:45	7	1	—	—	—	2	12	1	—	—	—	7
7:45 to 8:00	9	2	—	1	1	2	14	5	—	—	2	10
8:00 to 8:15	7	1	—	—	—	6	17	2	1	—	—	12
8:15 to 8:30	13	—	—	—	—	2	7	1	1	1	—	9
8:30 to 8:45	5	2	—	—	—	6	12	4	—	—	—	7
8:45 to 9:00	5	1	—	—	—	5	5	3	—	—	—	6
9:00 to 9:15	6	1	—	—	—	4	14	2	—	—	—	8
9:15 to 9:30	4	—	—	—	—	2	13	0	1	1	—	5
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-in Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

PHILIP HABIB & ASSOCIATE
226, W. 26th St. 9FL
New York, NY 10001
(212)929-5656

VC-7

Traffic / Pedestrian Movement Count Sheet

Project N 1121A
Location:

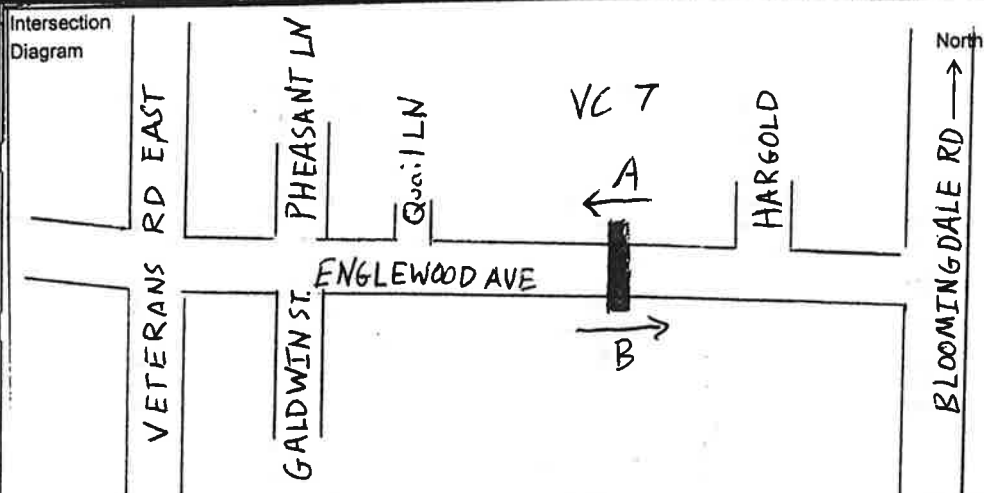
Date:

06/08/11

Period: MD

Weather Conditions:

Valentyna Yermakova
Surveyor's Name:



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
11:30 to 11:45	8	-	-	-	-	4	17	2	-	-	-	6
11:45 to 12:00	4	-	-	-	-	4	16	-	1	-	-	8
12:00 to 12:15	6	-	1	-	-	4	16	1	-	-	-	4
12:15 to 12:30	6	-	-	-	-	1	14	-	-	-	-	7
12:30 to 12:45	8	-	1	-	-	3	9	1	-	-	-	3
12:45 to 13:00	11	-	-	-	-	3	25	-	-	-	-	4
13:00 to 13:15	7	2	-	-	-	4	17	2	-	-	1	5
13:15 to 13:30	8	1	-	1	-	2	10	1	1	-	-	7
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

VC-7

Project N 1121A

Location :

Date:

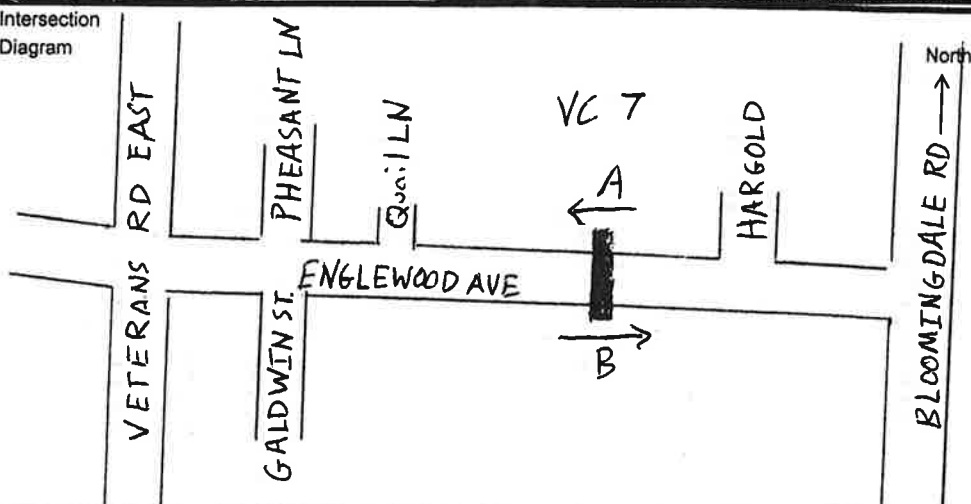
06/08/11

Period: PM

Weather Conditions:

Valentina Yermakova
Surveyor's Name:

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
16:30 to 16:45	9	-	-	-	1	5	23	-	2	1	-	8
16:45 to 17:00	10	-	-	-	-	4	19	1	-	-	-	13
17:00 to 17:15	13	3	-	-	-	3	17	3	1	-	-	11
17:15 to 17:30	12	-	-	-	-	4	15	1	-	-	-	7
17:30 to 17:45	10	-	-	-	-	8	17	2	-	-	-	6
17:45 to 18:00	8	-	-	-	-	6	10	2	-	1	-	6
18:00 to 18:15	12	1	-	-	-	8	11	2	1	-	-	9
18:15 to 18:30	11	-	-	-	-	3	16	3	-	-	1	11
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tail Pipe; Tractor-Trailers)

ABIB & ASSOCIATES
26th St. 9FL
New York, NY 10001
(212)929-5656

VC7

Traffic / Pedestrian Movement Count Sheet

Project No.: 1121A

Location:

Date:

06/11/11

Period:

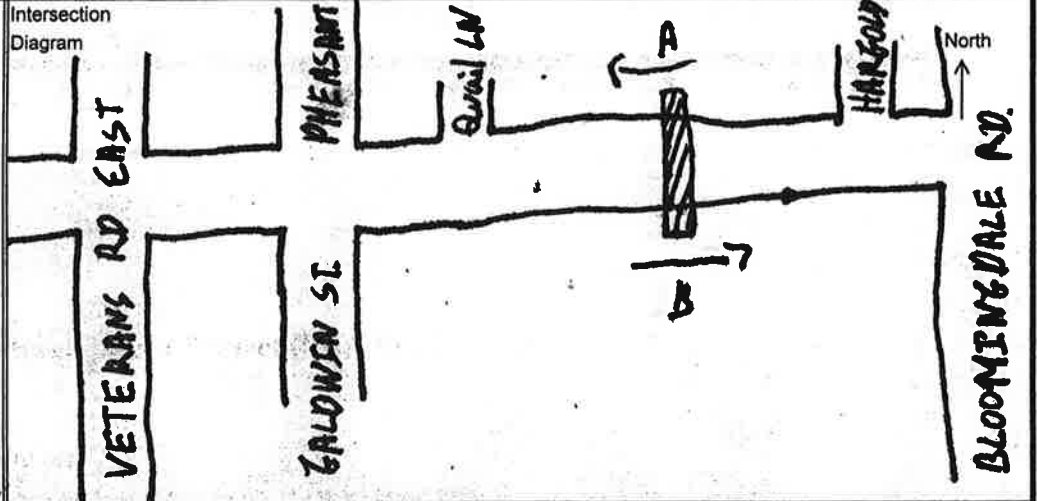
Weather Conditions:

rain

Surveyor's Name:

Valentina
Yermakova

Intersection
Diagram



Time	Location/Direction A						Location/Direction B					
	AUTO 1	LDT 2	HDT 3	DT 4	BUS 5	SUV 6	AUTO 7	LDT 8	HDT 9	DT 10	BUS 11	SUV 12
3:00 to 3:15	4	1	-	-	-	2	11	2	-	-	-	9
3:15 to 3:30	10	1	-	-	-	4	20	1	-	-	-	9
3:30 to 3:45	7	1	-	-	-	2	17	1	-	-	-	8
3:45 to 4:00	13	1	-	-	-	3	14	1	-	-	-	14
4:00 to 4:15	4	1	-	-	-	3	14	1	1	-	-	14
4:15 to 4:30	4	-	-	-	-	3	15	2	-	-	-	13
4:30 to 4:45	7	-	-	-	-	4	16	-	-	-	-	7
4:45 to 5:00	6	-	-	-	-	7	14	-	-	-	-	6
5:00 to 5:15	9	-	-	-	-	6	8	-	-	-	-	10
5:15 to 5:30	12	-	-	-	-	3	8	-	1	-	-	4
5:30 to 5:45	7	-	-	-	-	1	24	-	-	-	-	9
5:45 to 6:00	7	-	1	-	-	1	8	-	-	-	-	3
Peak Hour												

LDT= Light Duty Trucks (4 Wheels; Commercial Mini Vans; Mini School Buses)
HDT= Heavy Duty Trucks (6 or more Wheels; Walk-In Trucks)
DT= Diesel Trucks (with Vertical Tale Pipe; Tractor-Trailers)

Automatic Traffic Recorder Counts

Charleston ATR June 2011	Arthur Kill Rd NB South of Sharrots Rd				Arthur Kill Rd SB North of Sharrots Rd			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	39	48	51	46	31	30	31	31
6:45 - 7:00	32	39	40	37	45	50	33	43
7:00 - 7:15	40	46	40	42	33	47	42	41
7:15 - 7:30	57	44	50	50	49	53	49	50
7:30 - 7:45	53	45	58	52	61	51	50	54
7:45 - 8:00	61	64	60	62	46	56	44	49
8:00 - 8:15	52	72	48	57	51	49	49	50
8:15 - 8:30	44	47	41	44	50	43	34	42
8:30 - 8:45	55	53	29	46	39	42	39	40
8:45 - 9:00	53	50	33	45	47	64	55	55
9:00 - 9:15	46	59	53	53	57	52	57	55
9:15 - 9:30	36	45	45	42	37	46	43	42
Peak Hour Total	204	222	151	192	187	198	177	187
PHF	0.93	0.77	0.79	0.83	0.92	0.77	0.80	0.83
MD								
11:00 - 11:15	46	53	58	52	58	63	47	56
11:15 - 11:30	47	63	43	51	59	48	64	57
11:30 - 11:45	59	67	36	54	51	46	58	52
11:45 - 12:00	41	51	63	52	76	44	82	67
12:00 - 12:15	68	60	72	67	57	51	61	56
12:15 - 12:30	64	59	48	57	63	56	59	59
12:30 - 12:45	59	58	55	57	56	60	69	62
12:45 - 1:00	82	44	52	59	64	51	52	56
1:00 - 1:15	54	43	47	48	61	64	64	63
1:15 - 1:30	58	50	49	52	62	53	65	60
1:30 - 1:45	58	45	43	49	41	62	72	58
1:45 - 2:00	36	54	54	48	45	52	70	56
2:00 - 2:15	58	56	63	59	64	46	66	59
2:15 - 2:30	58	59	52	56	73	65	66	68
2:30 - 2:45	62	67	69	66	77	50	62	63
2:45 - 3:00	57	52	68	59	79	64	77	73
Peak Hour Total	273	221	227	240	240	218	241	233
PHF	0.83	0.92	0.79	0.85	0.94	0.91	0.87	0.91
PM								
4:00 - 4:15	80	78	66	75	65	105	63	78
4:15 - 4:30	55	62	67	61	68	71	73	71
4:30 - 4:45	59	59	60	59	57	59	68	61
4:45 - 5:00	60	89	74	74	68	58	59	62
5:00 - 5:15	62	98	66	75	78	89	73	80
5:15 - 5:30	45	76	45	55	44	61	66	57
5:30 - 5:45	50	92	54	65	46	58	66	57
5:45 - 6:00	67	85	65	72	66	68	60	65
6:00 - 6:15	73	73	68	71	54	33	41	43
6:15 - 6:30	61	77	61	66	36	40	39	38
6:30 - 6:45	52	56	53	54	56	48	47	50
6:45 - 7:00	39	62	53	51	32	41	41	38
Peak Hour Total	224	351	230	268	234	276	265	258
PHF	0.84	0.90	0.87	0.87	0.75	0.78	0.91	0.81

Charleston ATR June 2011	Arthur Kill Rd NB South of Sharrots Rd			Arthur Kill Rd SB North of Sharrots Rd		
	Sat 1	Sat 2	AVG	Sat 1	Sat 2	AVG
SMD						
12:00 - 12:15	55	48	52	54	45	50
12:15 - 12:30	67	43	55	47	56	52
12:30 - 12:45	58	50	54	57	47	52
12:45 - 1:00	60	45	53	66	59	63
1:00 - 1:15	64	50	57	59	50	55
1:15 - 1:30	65	59	62	65	74	70
1:30 - 1:45	56	59	58	60	60	60
1:45 - 2:00	55	47	51	62	55	59
2:00 - 2:15	54	38	46	56	49	53
2:15 - 2:30	54	52	53	48	40	44
2:30 - 2:45	33	47	40	55	62	59
2:45 - 3:00	46	47	47	44	41	43
3:00 - 3:15	43	37	40	63	39	51
3:15 - 3:30	40	35	38	52	42	47
3:30 - 3:45	48	39	44	44	38	41
3:45 - 4:00	51	51	51	52	48	50
4:00 - 4:15	44	41	43	45	48	47
4:15 - 4:30	44	38	41	41	29	35
4:30 - 4:45	36	35	36	56	44	50
4:45 - 5:00	33	48	41	39	49	44
5:00 - 5:15	43	51	47	39	42	41
5:15 - 5:30	35	33	34	29	29	29
5:30 - 5:45	33	40	37	30	28	29
5:45 - 6:00	24	29	27	33	51	42
Peak Hour Total	245	213	229	250	243	247
PHF	0.94	0.90	0.92	0.95	0.82	0.88

Charleston ATR June 2011	Arthur Kill Rd NB South of S Bridge St				Arthur Kill Rd SB North of N Bridge St			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	113	108	91	104	46	51	34	44
6:45 - 7:00	86	93	112	97	50	43	49	47
7:00 - 7:15	110	122	118	117	60	61	41	54
7:15 - 7:30	153	136	140	143	53	64	60	59
7:30 - 7:45	162	147	125	145	71	65	57	64
7:45 - 8:00	172	172	177	174	81	83	48	71
8:00 - 8:15	186	186	146	173	59	58	58	58
8:15 - 8:30	164	167	143	158	56	49	51	52
8:30 - 8:45	145	146	140	144	56	68	60	61
8:45 - 9:00	126	132	83	114	78	69	61	69
9:00 - 9:15	99	142	123	121	73	77	76	75
9:15 - 9:30	130	124	134	129	58	65	68	64
Peak Hour Total	621	631	512	588	249	244	230	241
PHF	0.83	0.85	0.88	0.85	0.80	0.88	0.94	0.87
MD								
11:00 - 11:15	129	126	132	129	93	74	80	82
11:15 - 11:30	145	123	102	123	74	81	83	79
11:30 - 11:45	140	127	84	117	78	93	82	84
11:45 - 12:00	109	130	146	128	95	90	105	97
12:00 - 12:15	164	140	130	145	87	64	80	//
12:15 - 12:30	142	103	130	125	83	108	88	93
12:30 - 12:45	153	127	138	139	76	84	99	86
12:45 - 1:00	159	143	118	140	79	78	74	77
1:00 - 1:15	97	135	125	119	87	83	72	81
1:15 - 1:30	118	115	129	121	92	74	91	86
1:30 - 1:45	116	128	118	121	78	87	80	82
1:45 - 2:00	99	119	124	114	86	87	83	85
2:00 - 2:15	146	116	116	126	77	89	61	76
2:15 - 2:30	118	132	139	130	84	103	89	92
2:30 - 2:45	178	169	164	170	97	75	89	87
2:45 - 3:00	139	144	143	142	79	78	88	82
Peak Hour Total	618	513	516	549	325	334	341	333
PHF	0.94	0.90	0.93	0.92	0.93	0.77	0.86	0.86
PM								
4:00 - 4:15	187	197	166	183	100	138	114	117
4:15 - 4:30	148	172	141	154	101	117	114	111
4:30 - 4:45	140	171	156	156	101	108	102	104
4:45 - 5:00	142	132	138	137	106	106	121	111
5:00 - 5:15	148	154	161	154	133	114	128	125
5:15 - 5:30	157	158	163	159	94	104	88	95
5:30 - 5:45	141	134	154	143	108	113	111	111
5:45 - 6:00	174	162	142	159	113	92	92	99
6:00 - 6:15	179	184	189	184	79	85	90	85
6:15 - 6:30	159	140	134	144	96	94	88	93
6:30 - 6:45	148	139	170	152	94	94	85	91
6:45 - 7:00	172	166	157	165	87	93	93	91
Peak Hour Total	620	608	620	616	448	423	419	430
PHF	0.89	0.94	0.95	0.93	0.84	0.93	0.82	0.86

Charleston ATR June 2011	Arthur Kill Rd NB South of S Bridge St				Arthur Kill Rd SB North of N Bridge St			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	152	160	156		104	100	102	
12:15 - 12:30	169	177	173		96	97	97	
12:30 - 12:45	173	146	160		115	99	107	
12:45 - 1:00	206	172	189	678	115	98	107	412
1:00 - 1:15	180	163	172	693	94	113	104	414
1:15 - 1:30	185	148	167	687	121	115	118	435
1:30 - 1:45	157	167	162	689	122	89	106	434
1:45 - 2:00	159	172	166	666	84	112	98	425
2:00 - 2:15	161	157	159	653	96	94	95	417
2:15 - 2:30	156	147	152	638	87	80	84	382
2:30 - 2:45	136	137	137	613	83	76	80	356
2:45 - 3:00	129	149	139	586	77	89	83	341
3:00 - 3:15	169	121	145	572	77	53	65	311
3:15 - 3:30	132	117	125	545	87	36	62	289
3:30 - 3:45	146	143	145	553	98	43	71	280
3:45 - 4:00	166	163	165	579	84	40	62	259
4:00 - 4:15	163	161	162	596	84	47	66	260
4:15 - 4:30	140	159	150	621	81	60	71	269
4:30 - 4:45	164	141	153	629	77	61	69	267
4:45 - 5:00	164	115	140	604	82	56	69	274
5:00 - 5:15	169	113	141	583	67	58	63	271
5:15 - 5:30	153	186	170	603	88	62	75	276
5:30 - 5:45	121	133	127	577	58	60	59	266
5:45 - 6:00	107	129	118	556	86	75	81	277
Peak Hour Total	728	650	689		452	415		434
PHF	0.88	0.94	0.91		0.93	0.90		0.91

Charleston ATR June 2011	Boscombe Ave WB East of Korean War Vet HW Ramp				Boscombe Ave EB West of Korean War Vet HW Ramp			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	34	33	38	35	166	178	161	168
6:45 - 7:00	40	50	48	46	180	178	171	176
7:00 - 7:15	58	58	65	60	181	194	181	185
7:15 - 7:30	58	73	63	65	212	220	221	218
7:30 - 7:45	75	78	72	75	228	218	214	220
7:45 - 8:00	80	89	83	84	260	275	210	248
8:00 - 8:15	104	75	60	80	278	246	207	244
8:15 - 8:30	110	99	95	101	288	276	221	262
8:30 - 8:45	126	91	108	108	225	228	222	225
8:45 - 9:00	88	93	91	91	232	226	190	216
9:00 - 9:15	91	118	105	105	190	206	207	201
9:15 - 9:30	98	89	78	88	212	189	196	199
Peak Hour Total	428	358	354	380	1023	976	840	946
PHF	0.85	0.90	0.82	0.86	0.89	0.88	0.95	0.91
MD								
11:00 - 11:15	187	138	134	153	220	201	218	213
11:15 - 11:30	158	126	128	137	218	205	52	158
11:30 - 11:45	160	135	146	147	216	202	216	211
11:45 - 12:00	141	129	154	141	219	221	242	227
12:00 - 12:15	159	147	155	154	245	246	239	243
12:15 - 12:30	164	171	187	174	266	186	213	222
12:30 - 12:45	178	188	170	179	228	238	223	230
12:45 - 1:00	190	160	184	178	222	200	215	212
1:00 - 1:15	184	162	169	172	214	218	212	215
1:15 - 1:30	177	165	165	169	245	228	206	226
1:30 - 1:45	172	179	152	168	213	219	209	214
1:45 - 2:00	168	152	156	159	232	203	221	219
2:00 - 2:15	160	193	147	167	206	229	206	214
2:15 - 2:30	172	158	173	168	233	226	240	233
2:30 - 2:45	154	144	146	148	277	263	297	279
2:45 - 3:00	141	145	136	141	213	255	214	227
Peak Hour Total	691	666	696	684	961	870	890	907
PHF	0.91	0.89	0.93	0.91	0.90	0.88	0.93	0.91
PM								
4:00 - 4:15	169	184	165	173	294	270	260	275
4:15 - 4:30	170	152	158	160	238	248	236	241
4:30 - 4:45	180	180	129	163	231	252	216	233
4:45 - 5:00	137	163	157	152	239	241	218	233
5:00 - 5:15	154	165	140	153	281	256	228	255
5:15 - 5:30	150	152	147	150	236	238	253	242
5:30 - 5:45	167	170	154	164	246	213	218	226
5:45 - 6:00	171	162	143	159	223	210	235	223
6:00 - 6:15	154	153	150	152	247	273	245	255
6:15 - 6:30	139	170	145	151	233	249	257	246
6:30 - 6:45	140	160	146	149	208	226	216	217
6:45 - 7:00	156	153	169	159	213	229	220	221
Peak Hour Total	642	649	584	625	986	917	934	946
PHF	0.94	0.95	0.95	0.95	0.88	0.90	0.92	0.90

Charleston ATR June 2011	Boscombe Ave WB				Boscombe Ave EB			
	East of Korean War Vet HW Ramp				West of Korean War Vet HW Ramp			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	202	188	195		257	251	254	
12:15 - 12:30	201	202	202		271	241	256	
12:30 - 12:45	198	178	188		269	273	271	
12:45 - 1:00	225	207	216	801	264	272	268	1049
1:00 - 1:15	191	190	191	796	303	267	285	1080
1:15 - 1:30	213	221	217	812	278	276	277	1101
1:30 - 1:45	223	209	216	840	290	260	275	1105
1:45 - 2:00	186	205	196	819	294	313	304	1141
2:00 - 2:15	202	206	204	833	259	302	281	1136
2:15 - 2:30	223	185	204	820	271	241	256	1115
2:30 - 2:45	194	208	201	805	230	244	237	1077
2:45 - 3:00	206	187	197	806	247	247	247	1021
3:00 - 3:15	229	178	204	805	246	199	223	963
3:15 - 3:30	206	181	194	795	222	269	246	952
3:30 - 3:45	191	173	182	776	260	229	245	960
3:45 - 4:00	237	193	215	794	255	263	259	972
4:00 - 4:15	206	188	197	788	249	239	244	993
4:15 - 4:30	218	173	196	790	262	243	253	1000
4:30 - 4:45	207	176	192	799	232	228	230	986
4:45 - 5:00	196	165	181	765	226	231	229	955
5:00 - 5:15	153	171	162	730	261	212	237	948
5:15 - 5:30	185	158	172	706	213	253	233	928
5:30 - 5:45	215	158	187	701	227	237	232	930
5:45 - 6:00	184	151	168	688	223	203	213	915
Peak Hour Total	852	827	840		1135	1075	1105	
PHF	0.95	0.94	0.94		0.94	0.97	0.96	

Charleston ATR June 2011	Veterans Rd West EB *				Veterans Rd West WB *					
	West of N Bridge St				East of N Bridge St					
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG		
AM										
6:30 - 6:45	39	56	39	45	52	52	42	49		
6:45 - 7:00	36	41	44	40	73	49	75	66		
7:00 - 7:15	68	72	57	66	53	79	69	67		
7:15 - 7:30	63	92	71	75	226	78	101	75	85	266
7:30 - 7:45	73	61	57	64	245	143	108	90	114	331
7:45 - 8:00	102	85	76	88	292	134	194	133	154	419
8:00 - 8:15	86	102	72	87	313	114	162	127	134	486
8:15 - 8:30	90	87	75	84	322	108	191	111	137	538
8:30 - 8:45	94	73	83	83	342	91	189	174	151	576
8:45 - 9:00	67	70	77	71	325	113	95	174	127	550
9:00 - 9:15	62	78	71	70	309	80	181	198	153	568
9:15 - 9:30	71	77	75	74	299	115	168	193	159	590
Peak Hour Total	337	332	307	325	426	637	586	550		
PHF	0.90	0.81	0.92	0.88	0.93	0.83	0.84	0.87		
MD										
11:00 - 11:15	70	85	85	80	160	125	199	161		
11:15 - 11:30	90	71	65	75	157	185	232	191		
11:30 - 11:45	85	84	60	76	126	163	169	153		
11:45 - 12:00	90	83	82	85	317	132	185	192	170	675
12:00 - 12:15	68	81	86	78	315	150	145	186	160	674
12:15 - 12:30	80	83	65	76	316	150	183	156	163	646
12:30 - 12:45	104	76	80	87	326	148	200	191	180	673
12:45 - 1:00	92	103	69	88	329	166	157	164	162	665
1:00 - 1:15	84	75	76	78	329	111	170	196	159	664
1:15 - 1:30	74	67	67	69	322	126	142	158	142	643
1:30 - 1:45	97	82	63	81	316	158	159	182	166	630
1:45 - 2:00	73	71	74	73	301	153	145	157	152	619
2:00 - 2:15	93	79	69	80	303	138	193	188	173	633
2:15 - 2:30	82	89	85	85	319	148	160	157	155	646
2:30 - 2:45	118	82	76	92	330	199	162	184	182	661
2:45 - 3:00	90	80	75	82	339	162	224	148	178	688
Peak Hour Total	344	343	300	329	614	685	697	665		
PHF	0.83	0.83	0.87	0.84	0.92	0.86	0.91	0.90		
PM										
4:00 - 4:15	124	100	114	113	118	178	120	139		
4:15 - 4:30	104	119	91	105	135	136	104	125		
4:30 - 4:45	110	132	107	116	147	115	116	126		
4:45 - 5:00	106	111	103	107	440	245	125	131	167	557
5:00 - 5:15	112	121	135	123	450	195	103	161	153	571
5:15 - 5:30	111	116	119	115	461	117	102	239	153	599
5:30 - 5:45	85	110	101	99	443	130	137	256	174	647
5:45 - 6:00	105	95	87	96	432	124	118	250	164	644
6:00 - 6:15	98	118	91	102	412	111	141	231	161	652
6:15 - 6:30	72	89	91	84	381	108	119	196	141	640
6:30 - 6:45	78	81	81	80	362	112	100	198	137	603
6:45 - 7:00	93	84	74	84	350	120	145	191	152	591
Peak Hour Total	413	442	442	432	566	460	906	644		
PHF	0.92	0.91	0.82	0.88	0.73	0.84	0.88	0.82		

*Note - Median ATR value for MD peak (343) was used in
balancing network to avoid a dramatic reduction of
manual traffic counts

*Note - Median ATR value for PM peak (566) was used in
balancing network to avoid a dramatic increase of
manual traffic counts

Charleston ATR June 2011	Veterans Rd West EB West of N Bridge St				Veterans Rd West WB East of N Bridge St			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	113	111	112		105	199	152	
12:15 - 12:30	120	120	120		130	220	175	
12:30 - 12:45	123	81	102		113	213	163	
12:45 - 1:00	105	110	108	442	145	214	180	670
1:00 - 1:15	127	107	117	447	117	208	163	680
1:15 - 1:30	133	108	121	447	140	190	165	670
1:30 - 1:45	111	94	103	448	233	141	187	694
1:45 - 2:00	99	105	102	442	197	154	176	690
2:00 - 2:15	128	102	115	440	139	139	139	667
2:15 - 2:30	102	102	102	422	115	151	133	635
2:30 - 2:45	98	99	99	418	107	128	118	565
2:45 - 3:00	94	119	107	422	125	125	125	515
3:00 - 3:15	138	109	124	431	113	91	102	478
3:15 - 3:30	120	84	102	431	108	108	108	453
3:30 - 3:45	103	91	97	429	146	131	139	474
3:45 - 4:00	105	101	103	426	123	107	115	464
4:00 - 4:15	100	122	111	413	139	107	123	485
4:15 - 4:30	96	108	102	413	93	132	113	489
4:30 - 4:45	131	91	111	427	99	151	125	476
4:45 - 5:00	110	86	98	422	104	144	124	485
5:00 - 5:15	111	102	107	418	94	138	116	478
5:15 - 5:30	104	109	107	422	95	124	110	475
5:30 - 5:45	81	81	81	392	77	88	83	432
5:45 - 6:00	70	68	69	363	101	107	104	412
Peak Hour Total	476	419	448		635	753		694
PHF	0.89	0.95	0.92		0.68	0.88		0.78

Charleston ATR June 2011	Korean War Vet HW WB Off-Ramp South of Veterans Rd West					Tyrellan Ave NB South of Veterans Rd West				
	Tues	Wed	Thur	AVG		Tues	Wed	Thur	AVG	
AM										
6:30 - 6:45	94	83	91	89		32	45	43	40	
6:45 - 7:00	105	113	112	110		49	42	46	46	
7:00 - 7:15	94	75	87	85		43	46	55	48	
7:15 - 7:30	112	114	113	113	398	56	64	61	60	194
7:30 - 7:45	162	148	118	143	451	56	63	53	57	211
7:45 - 8:00	139	156	170	155	496	89	86	67	81	246
8:00 - 8:15	153	153	128	145	555	84	86	59	76	275
8:15 - 8:30	134	139	146	140	582	88	106	68	87	302
8:30 - 8:45	156	130	144	143	583	81	80	82	81	325
8:45 - 9:00	124	142	138	135	562	93	74	71	79	324
9:00 - 9:15	142	139	151	144	562	87	72	86	82	329
9:15 - 9:30	139	152	146	146	568	78	82	84	81	323
Peak Hour Total	567	564	556	562		346	346	280		324
PHF	0.91	0.92	0.95	0.93		0.93	0.82	0.85		0.87
MD										
11:00 - 11:15	138	121	139	133		103	89	97	96	
11:15 - 11:30	148	144	163	152		90	96	98	95	
11:30 - 11:45	158	169	136	154		100	86	113	100	
11:45 - 12:00	179	157	159	165	604	106	90	114	103	394
12:00 - 12:15	164	151	166	160	631	109	106	132	116	413
12:15 - 12:30	155	137	142	145	624	94	105	102	100	419
12:30 - 12:45	139	148	164	150	620	109	128	112	116	436
12:45 - 1:00	142	143	135	140	595	90	86	103	93	425
1:00 - 1:15	131	135	142	136	571	93	96	91	93	403
1:15 - 1:30	156	133	143	144	570	95	93	85	91	394
1:30 - 1:45	148	152	141	147	567	104	101	85	97	374
1:45 - 2:00	145	187	146	159	586	98	82	90	90	371
2:00 - 2:15	166	190	137	164	615	83	76	93	84	362
2:15 - 2:30	144	155	154	151	622	110	97	89	99	369
2:30 - 2:45	169	200	159	176	651	108	99	110	106	378
2:45 - 3:00	166	223	193	194	685	96	111	92	100	388
Peak Hour Total	600	579	607	595		402	425	449		425
PHF	0.91	0.96	0.91	0.93		0.92	0.83	0.85		0.87
PM										
4:00 - 4:15	210	232	208	217		111	113	91	105	
4:15 - 4:30	175	200	177	184		120	101	86	102	
4:30 - 4:45	182	210	184	192		96	88	71	85	
4:45 - 5:00	189	229	127	182	774	103	115	83	100	393
5:00 - 5:15	204	197	187	196	754	108	93	104	102	389
5:15 - 5:30	201	222	202	208	778	90	98	105	98	385
5:30 - 5:45	194	189	210	198	784	99	96	83	93	392
5:45 - 6:00	209	246	213	223	825	103	78	95	92	384
6:00 - 6:15	181	202	206	196	825	98	103	95	99	381
6:15 - 6:30	181	238	199	206	823	93	89	105	96	379
6:30 - 6:45	215	265	209	230	855	74	75	89	79	366
6:45 - 7:00	194	208	209	204	836	83	88	75	82	356
Peak Hour Total	808	854	812	825		400	365	387		384
PHF	0.97	0.87	0.95	0.93		0.93	0.93	0.92		0.93

Charleston ATR June 2011	Korean War Vet HW WB Off-Ramp South of Veterans Rd West				Tyrellan Ave NB South of Veterans Rd West			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	177	159	168		119	106	113	
12:15 - 12:30	174	176	175		131	98	115	
12:30 - 12:45	190	155	173		121	127	124	
12:45 - 1:00	176	176	176	692	119	122	121	472
1:00 - 1:15	144	197	171	694	128	130	129	488
1:15 - 1:30	193	164	179	698	117	143	130	504
1:30 - 1:45	192	167	180	705	119	105	112	492
1:45 - 2:00	189	152	171	699	115	122	119	490
2:00 - 2:15	151	151	151	680	129	158	144	504
2:15 - 2:30	184	149	167	668	115	118	117	491
2:30 - 2:45	166	164	165	653	108	118	113	492
2:45 - 3:00	164	167	166	648	122	97	110	483
3:00 - 3:15	176	156	166	663	100	79	90	429
3:15 - 3:30	187	160	174	670	103	117	110	422
3:30 - 3:45	221	155	188	693	126	102	114	423
3:45 - 4:00	213	167	190	718	100	109	105	418
4:00 - 4:15	165	173	169	721	91	101	96	425
4:15 - 4:30	166	189	178	725	104	108	106	421
4:30 - 4:45	178	171	175	711	103	96	100	406
4:45 - 5:00	173	154	164	685	82	104	93	395
5:00 - 5:15	146	136	141	657	97	94	96	394
5:15 - 5:30	165	134	150	629	74	98	86	374
5:30 - 5:45	174	134	154	608	71	83	77	352
5:45 - 6:00	194	150	172	617	102	87	95	353
Peak Hour Total	705	704	705		483	500	492	
PHF	0.91	0.89	0.90		0.94	0.87	0.91	

Charleston ATR June 2011	Tyrellan Ave SB North of Veterans Rd West				Mohr Rd WB (In) East of Tyrellan Ave			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	16	22	19	19	8	14	16	13
6:45 - 7:00	14	21	24	20	14	21	22	19
7:00 - 7:15	33	36	30	33	17	19	19	18
7:15 - 7:30	19	24	22	22	21	23	13	19
7:30 - 7:45	25	27	33	28	15	21	22	19
7:45 - 8:00	19	22	31	24	29	36	33	33
8:00 - 8:15	26	32	40	33	42	41	36	40
8:15 - 8:30	49	45	49	48	33	45	32	37
8:30 - 8:45	42	52	60	51	48	50	37	45
8:45 - 9:00	60	65	69	65	42	68	56	55
9:00 - 9:15	63	70	48	60	54	55	55	55
9:15 - 9:30	66	81	74	74	75	52	54	60
Peak Hour Total	177	194	218	196	165	204	161	177
PHF	0.74	0.75	0.79	0.76	0.86	0.75	0.72	0.78
MD								
11:00 - 11:15	96	87	93	92	69	83	66	73
11:15 - 11:30	105	88	116	103	88	63	70	74
11:30 - 11:45	104	112	131	116	78	67	76	74
11:45 - 12:00	105	119	157	127	81	72	81	78
12:00 - 12:15	125	139	124	129	110	86	82	93
12:15 - 12:30	145	138	150	144	97	66	68	77
12:30 - 12:45	112	100	132	115	108	88	68	88
12:45 - 1:00	126	130	141	132	73	92	80	82
1:00 - 1:15	139	138	136	138	75	78	52	68
1:15 - 1:30	126	150	122	133	74	79	66	73
1:30 - 1:45	151	129	107	129	71	67	55	64
1:45 - 2:00	137	115	111	121	67	56	57	60
2:00 - 2:15	130	142	121	131	71	69	80	73
2:15 - 2:30	123	102	102	109	59	45	67	57
2:30 - 2:45	112	120	105	112	61	67	67	65
2:45 - 3:00	114	126	103	114	76	55	54	62
Peak Hour Total	508	507	547	521	388	332	298	339
PHF	0.88	0.91	0.91	0.90	0.88	0.90	0.91	0.90
PM								
4:00 - 4:15	124	141	108	124	76	72	66	71
4:15 - 4:30	112	137	113	121	53	74	58	62
4:30 - 4:45	113	133	111	119	58	67	67	64
4:45 - 5:00	113	134	132	126	80	79	71	77
5:00 - 5:15	97	99	122	106	67	83	62	71
5:15 - 5:30	93	106	117	105	63	72	65	67
5:30 - 5:45	107	108	109	108	64	64	55	61
5:45 - 6:00	91	113	120	108	62	61	66	63
6:00 - 6:15	87	110	124	107	70	60	66	65
6:15 - 6:30	94	93	101	96	69	57	56	61
6:30 - 6:45	91	709	77	292	69	70	60	66
6:45 - 7:00	92	79	86	86	74	74	56	68
Peak Hour Total	388	426	468	427	256	280	248	261
PHF	0.91	0.94	0.96	0.94	0.96	0.84	0.94	0.91

*Note - ATR Data lost from 6/7 -6/10, Weekday data
based on 6/14 - 6/16

Charleston ATR June 2011	Tyrellan Ave SB North of Veterans Rd West				Mohr Rd WB (In) East of Tyrellan Ave			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	175	145	160		106	109	108	
12:15 - 12:30	166	159	163		121	108	115	
12:30 - 12:45	174	184	179		97	121	109	
12:45 - 1:00	179	159	169	671	119	128	124	455
1:00 - 1:15	157	153	155	666	98	110	104	451
1:15 - 1:30	179	187	183	686	105	104	105	441
1:30 - 1:45	177	171	174	681	116	116	116	448
1:45 - 2:00	172	155	164	676	125	94	110	434
2:00 - 2:15	171	162	167	687	131	97	114	444
2:15 - 2:30	187	195	191	695	99	96	98	437
2:30 - 2:45	154	162	158	679	109	96	103	424
2:45 - 3:00	172	141	157	672	97	98	98	412
3:00 - 3:15	183	145	164	670	109	74	92	389
3:15 - 3:30	183	142	163	641	87	74	81	372
3:30 - 3:45	191	131	161	644	111	78	95	364
3:45 - 4:00	184	149	167	654	121	83	102	369
4:00 - 4:15	179	155	167	657	113	80	97	374
4:15 - 4:30	163	126	145	639	96	77	87	380
4:30 - 4:45	178	134	156	634	87	71	79	364
4:45 - 5:00	164	151	158	625	88	66	77	339
5:00 - 5:15	123	122	123	581	89	84	87	329
5:15 - 5:30	160	124	142	578	75	67	71	314
5:30 - 5:45	159	122	141	563	76	73	75	309
5:45 - 6:00	134	112	123	528	88	78	83	315
Peak Hour Total	692	670	681		438	458	448	
PHF	0.97	0.90	0.93		0.92	0.89	0.91	

Charleston ATR June 2011	Mohr Rd EB (Out) East of Tyrellan Ave					Veterans Rd NB South of Englewood Ave				
	Tues	Wed	Thur	AVG		Tues	Wed	Thur	AVG	
AM										
6:30 - 6:45	5	2	0	2		9	5	7	7	
6:45 - 7:00	3	6	4	4		5	10	9	8	
7:00 - 7:15	5	4	7	5		4	13	20	12	
7:15 - 7:30	9	16	13	13	25	3	34	16	18	45
7:30 - 7:45	10	11	14	12	34	12	20	27	20	58
7:45 - 8:00	6	15	11	11	40	9	42	25	25	75
8:00 - 8:15	11	11	11	11	46	8	44	23	25	88
8:15 - 8:30	15	17	17	16	50	23	53	33	36	106
8:30 - 8:45	14	29	16	20	58	26	55	35	39	125
8:45 - 9:00	16	19	15	17	64	32	38	27	32	132
9:00 - 9:15	23	31	17	24	76	35	51	36	41	148
9:15 - 9:30	26	22	22	23	83	47	42	48	46	157
Peak Hour Total	56	76	59	64		89	190	118		132
PHF	0.88	0.66	0.87	0.80		0.70	0.86	0.84		0.80
MD										
11:00 - 11:15	71	37	44	51		108	64	77	83	
11:15 - 11:30	33	44	31	36		72	66	58	65	
11:30 - 11:45	41	48	37	42		85	73	68	75	
11:45 - 12:00	37	39	29	35	164	78	75	62	72	295
12:00 - 12:15	44	28	40	37	150	72	67	79	73	285
12:15 - 12:30	38	32	39	36	151	85	55	79	73	293
12:30 - 12:45	44	42	40	42	151	78	69	74	74	291
12:45 - 1:00	49	48	34	44	159	87	85	68	80	299
1:00 - 1:15	60	53	55	56	178	94	102	78	91	318
1:15 - 1:30	50	29	47	42	184	101	64	88	84	329
1:30 - 1:45	50	59	33	47	189	89	99	57	82	337
1:45 - 2:00	47	50	43	47	192	81	75	80	79	336
2:00 - 2:15	48	54	32	45	181	74	82	64	73	318
2:15 - 2:30	39	43	44	42	181	76	78	69	74	308
2:30 - 2:45	48	36	49	44	178	75	83	90	83	309
2:45 - 3:00	45	40	33	39	170	72	92	56	73	304
Peak Hour Total	175	150	153	159		322	276	300		299
PHF	0.89	0.78	0.96	0.88		0.93	0.81	0.95		0.90
PM										
4:00 - 4:15	34	40	43	39		84	86	87	86	
4:15 - 4:30	52	36	46	45		107	82	81	90	
4:30 - 4:45	39	55	39	44		77	96	84	86	
4:45 - 5:00	33	39	40	37	165	78	95	81	85	346
5:00 - 5:15	40	52	44	45	172	96	106	88	97	357
5:15 - 5:30	39	46	29	38	165	84	99	76	86	353
5:30 - 5:45	36	51	32	40	160	78	107	74	86	354
5:45 - 6:00	35	44	27	35	158	78	79	65	74	343
6:00 - 6:15	41	41	44	42	155	92	99	87	93	339
6:15 - 6:30	40	33	29	34	151	82	80	69	77	330
6:30 - 6:45	32	39	32	34	146	64	72	80	72	316
6:45 - 7:00	47	37	27	37	147	99	83	101	94	336
Peak Hour Total	150	193	132	158		336	391	303		343
PHF	0.94	0.93	0.75	0.87		0.88	0.91	0.86		0.88

Charleston ATR June 2011	Mohr Rd EB (Out) East of Tyrellan Ave				Veterans Rd NB South of Englewood Ave			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	74	61	68		110	84	97	
12:15 - 12:30	70	52	61		106	105	106	
12:30 - 12:45	59	57	58		98	101	100	
12:45 - 1:00	75	63	69	256	114	107	111	413
1:00 - 1:15	58	63	61	249	110	101	106	421
1:15 - 1:30	74	86	80	268	110	136	123	439
1:30 - 1:45	68	58	63	273	93	103	98	437
1:45 - 2:00	61	65	63	267	99	114	107	433
2:00 - 2:15	76	67	72	278	128	132	130	458
2:15 - 2:30	83	69	76	274	118	112	115	450
2:30 - 2:45	62	50	56	267	93	100	97	448
2:45 - 3:00	64	55	60	263	102	92	97	439
3:00 - 3:15	65	62	64	255	97	103	100	409
3:15 - 3:30	63	58	61	240	109	107	108	402
3:30 - 3:45	66	55	61	244	91	82	87	392
3:45 - 4:00	66	49	58	242	111	93	102	397
4:00 - 4:15	76	62	69	248	117	107	112	409
4:15 - 4:30	63	44	54	241	110	74	92	393
4:30 - 4:45	78	39	59	239	119	86	103	409
4:45 - 5:00	66	43	55	236	102	75	89	395
5:00 - 5:15	54	40	47	214	89	79	84	367
5:15 - 5:30	62	54	58	218	83	96	90	365
5:30 - 5:45	51	56	54	213	80	97	89	351
5:45 - 6:00	57	40	49	207	84	69	77	339
Peak Hour Total	275	270	273		427	447	437	
PHF	0.92	0.78	0.85		0.94	0.82	0.88	

Charleston ATR June 2011	Veterans Rd SB North of Englewood Ave				Sharrots Rd EB West of NB West Shore Parkway Service Rd			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	16	15	8	13	13	12	9	11
6:45 - 7:00	15	8	17	13	12	10	12	11
7:00 - 7:15	26	26	22	25	21	20	16	19
7:15 - 7:30	27	38	21	29	12	11	6	10
7:30 - 7:45	41	37	17	32	18	8	24	17
7:45 - 8:00	45	50	22	39	22	16	11	16
8:00 - 8:15	51	39	28	39	15	15	20	17
8:15 - 8:30	41	48	31	40	13	14	9	12
8:30 - 8:45	38	32	37	36	20	12	15	16
8:45 - 9:00	36	33	28	32	19	18	15	17
9:00 - 9:15	30	37	29	32	15	11	12	13
9:15 - 9:30	37	24	37	33	2	17	8	9
Peak Hour Total	166	152	124	147	67	59	59	62
PHF	0.81	0.79	0.84	0.81	0.84	0.82	0.74	0.80
MD								
11:00 - 11:15	44	34	41	40	14	27	12	18
11:15 - 11:30	42	40	38	40	21	13	12	15
11:30 - 11:45	51	39	37	42	20	17	14	17
11:45 - 12:00	46	49	48	48	27	13	15	18
12:00 - 12:15	63	33	40	45	28	18	18	21
12:15 - 12:30	46	33	42	40	23	20	15	19
12:30 - 12:45	37	44	34	38	23	18	15	19
12:45 - 1:00	34	53	38	42	22	14	13	16
1:00 - 1:15	45	45	40	43	26	11	28	22
1:15 - 1:30	57	39	42	46	27	20	20	22
1:30 - 1:45	38	44	34	39	22	17	17	19
1:45 - 2:00	40	41	38	40	13	13	19	15
2:00 - 2:15	51	42	39	44	21	27	15	21
2:15 - 2:30	42	33	39	38	28	17	16	20
2:30 - 2:45	35	45	22	34	17	14	18	16
2:45 - 3:00	42	43	43	43	32	18	22	24
Peak Hour Total	180	163	154	166	96	70	61	76
PHF	0.71	0.77	0.92	0.80	0.86	0.88	0.85	0.86
PM								
4:00 - 4:15	48	65	54	56	42	60	39	47
4:15 - 4:30	35	50	49	45	29	31	22	27
4:30 - 4:45	52	49	45	49	42	27	33	34
4:45 - 5:00	55	54	46	52	27	23	26	25
5:00 - 5:15	43	54	46	48	37	38	33	36
5:15 - 5:30	46	51	48	48	24	23	25	24
5:30 - 5:45	50	53	54	52	26	36	35	32
5:45 - 6:00	46	39	45	43	22	27	25	25
6:00 - 6:15	46	62	62	57	31	38	37	35
6:15 - 6:30	47	45	58	50	30	26	30	29
6:30 - 6:45	46	45	42	44	14	21	17	17
6:45 - 7:00	47	41	33	40	23	17	25	22
Peak Hour Total	185	197	193	192	109	124	118	117
PHF	0.93	0.91	0.89	0.91	0.74	0.82	0.84	0.80

Charleston ATR June 2011	Veterans Rd SB North of Englewood Ave				Sharrots Rd EB West of NB West Shore Parkway Service Rd			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	60	68	64		17	14	16	
12:15 - 12:30	67	52	60		14	24	19	
12:30 - 12:45	69	64	67		26	30	28	
12:45 - 1:00	50	69	60	250	19	24	22	84
1:00 - 1:15	61	69	65	251	16	19	18	86
1:15 - 1:30	65	56	61	252	27	8	18	85
1:30 - 1:45	53	56	55	240	31	21	26	83
1:45 - 2:00	61	62	62	242	17	20	19	80
2:00 - 2:15	55	50	53	229	30	24	27	89
2:15 - 2:30	47	71	59	228	21	13	17	89
2:30 - 2:45	52	33	43	216	45	44	45	107
2:45 - 3:00	59	58	59	213	23	15	19	108
3:00 - 3:15	48	39	44	204	12	20	16	97
3:15 - 3:30	61	54	58	202	8	14	11	91
3:30 - 3:45	52	45	49	208	17	8	13	59
3:45 - 4:00	67	38	53	202	21	17	19	59
4:00 - 4:15	50	49	50	208	21	15	18	61
4:15 - 4:30	52	47	50	200	19	10	15	64
4:30 - 4:45	51	50	51	202	24	15	20	71
4:45 - 5:00	42	37	40	189	18	19	19	71
5:00 - 5:15	36	57	47	186	18	19	19	71
5:15 - 5:30	37	41	39	176	21	13	17	74
5:30 - 5:45	35	44	40	165	13	9	11	65
5:45 - 6:00	41	37	39	164	15	12	14	60
Peak Hour Total	229	250	240		93	72		83
PHF	0.88	0.91	0.89		0.75	0.75		0.75

Charleston ATR June 2011	Sharrots Rd WB East of NB West Shore Parkway Service Rd				Bloomingdale Rd NB South of Sharrots Rd			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	13	11	4	9	60	60	37	52
6:45 - 7:00	11	11	15	12	65	69	64	66
7:00 - 7:15	21	18	14	18	72	62	48	61
7:15 - 7:30	22	19	15	19	71	67	66	68
7:30 - 7:45	35	38	18	30	83	83	77	81
7:45 - 8:00	32	26	17	25	102	106	68	92
8:00 - 8:15	30	30	17	26	107	99	70	92
8:15 - 8:30	28	17	18	21	92	107	87	95
8:30 - 8:45	14	21	24	20	81	95	81	86
8:45 - 9:00	24	34	21	26	76	89	82	82
9:00 - 9:15	24	23	21	23	92	80	85	86
9:15 - 9:30	17	18	19	18	64	62	72	66
Peak Hour Total	96	102	80	93	356	390	320	355
PHF	0.80	0.75	0.83	0.79	0.83	0.91	0.92	0.89
MD								
11:00 - 11:15	15	13	23	17	78	75	82	78
11:15 - 11:30	20	23	16	20	82	75	62	73
11:30 - 11:45	52	19	24	32	87	69	73	76
11:45 - 12:00	31	35	31	32	70	88	94	84
12:00 - 12:15	36	19	26	27	94	77	89	87
12:15 - 12:30	28	21	14	21	71	72	71	71
12:30 - 12:45	25	26	20	24	104	49	77	77
12:45 - 1:00	17	32	23	24	89	83	84	85
1:00 - 1:15	17	22	23	21	78	82	80	80
1:15 - 1:30	22	18	23	21	70	83	76	76
1:30 - 1:45	18	20	9	16	86	74	83	81
1:45 - 2:00	22	19	27	23	83	103	71	86
2:00 - 2:15	27	19	20	22	72	77	66	72
2:15 - 2:30	25	19	23	22	116	90	94	100
2:30 - 2:45	21	26	29	25	104	113	67	95
2:45 - 3:00	16	20	22	19	86	104	79	90
Peak Hour Total	106	98	83	96	358	281	321	320
PHF	0.74	0.77	0.80	0.77	0.86	0.85	0.90	0.87
PM								
4:00 - 4:15	40	27	19	29	112	91	83	95
4:15 - 4:30	28	39	33	33	110	93	94	99
4:30 - 4:45	29	26	20	25	115	91	101	102
4:45 - 5:00	28	34	20	27	99	125	79	101
5:00 - 5:15	32	35	27	31	113	99	114	109
5:15 - 5:30	26	42	26	31	94	115	97	102
5:30 - 5:45	24	30	22	25	105	92	92	96
5:45 - 6:00	0	21	27	16	96	82	127	102
6:00 - 6:15	0	36	28	21	95	107	91	98
6:15 - 6:30	0	27	21	16	88	110	98	99
6:30 - 6:45	0	20	23	14	83	93	94	90
6:45 - 7:00	0	27	41	23	103	80	86	90
Peak Hour Total	82	128	102	104	408	388	430	409
PHF	0.64	0.76	0.94	0.78	0.90	0.84	0.85	0.86

Charleston ATR June 2011	Sharrots Rd WB East of NB West Shore Parkway Service Rd				Bloomingdale Rd NB South of Sharrots Rd			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	35	34	35		115	106	111	
12:15 - 12:30	38	19	29		105	97	101	
12:30 - 12:45	24	34	29		94	85	90	
12:45 - 1:00	25	26	26	118	113	92	103	404
1:00 - 1:15	34	33	34	117	103	89	96	389
1:15 - 1:30	29	23	26	114	104	108	106	394
1:30 - 1:45	30	35	33	118	106	103	105	409
1:45 - 2:00	36	31	34	126	112	75	94	400
2:00 - 2:15	28	26	27	119	93	97	95	399
2:15 - 2:30	22	43	33	126	102	114	108	401
2:30 - 2:45	34	32	33	126	102	64	83	380
2:45 - 3:00	30	21	26	118	80	72	76	362
3:00 - 3:15	32	24	28	119	97	87	92	359
3:15 - 3:30	32	29	31	117	89	97	93	344
3:30 - 3:45	41	30	36	120	87	92	90	351
3:45 - 4:00	35	24	30	124	102	99	101	375
4:00 - 4:15	38	32	35	131	91	97	94	377
4:15 - 4:30	26	26	26	126	104	69	87	371
4:30 - 4:45	33	29	31	122	96	73	85	366
4:45 - 5:00	27	28	28	120	96	91	94	359
5:00 - 5:15	25	29	27	112	82	62	72	337
5:15 - 5:30	17	20	19	104	89	74	82	332
5:30 - 5:45	22	26	24	97	93	82	88	335
5:45 - 6:00	25	26	26	95	65	58	62	303
Peak Hour Total	118	117	118		426	392		409
PHF	0.87	0.84	0.85		0.94	0.91		0.92

Charleston ATR June 2011	Bloomington Rd SB North of Sharrots Rd					Bloomington Rd SB North of Amboy Ave				
	Tues	Wed	Thur	AVG		Tues	Wed	Thur	AVG	
AM										
6:30 - 6:45	48	44	32	41		42	32	38	37	
6:45 - 7:00	54	49	42	48		58	44	40	47	
7:00 - 7:15	62	59	43	55		64	70	47	60	
7:15 - 7:30	86	73	54	71	215	86	70	55	70	215
7:30 - 7:45	100	84	71	85	259	122	102	91	105	283
7:45 - 8:00	98	80	78	85	296	145	119	89	118	353
8:00 - 8:15	100	102	75	92	334	152	146	104	134	427
8:15 - 8:30	104	92	67	88	350	103	113	80	99	455
8:30 - 8:45	73	84	62	73	338	90	92	67	83	433
8:45 - 9:00	75	76	84	78	331	81	91	90	87	403
9:00 - 9:15	68	76	74	73	312	82	83	76	80	349
9:15 - 9:30	64	68	59	64	288	60	62	76	66	317
Peak Hour Total	352	354	288	331		426	442	341		403
PHF	0.85	0.87	0.86	0.86		0.70	0.76	0.82		0.76
MD										
11:00 - 11:15	97	69	73	80		96	87	79	87	
11:15 - 11:30	86	84	79	83		104	82	82	89	
11:30 - 11:45	82	69	78	76		90	83	97	90	
11:45 - 12:00	85	74	83	81	320	104	101	110	105	372
12:00 - 12:15	84	73	87	81	321	111	76	93	93	378
12:15 - 12:30	83	73	72	76	314	106	101	87	98	386
12:30 - 12:45	77	69	80	75	313	95	73	82	83	380
12:45 - 1:00	82	85	71	79	312	77	99	94	90	365
1:00 - 1:15	84	68	88	80	311	90	90	73	84	356
1:15 - 1:30	83	74	84	80	315	81	91	73	82	339
1:30 - 1:45	77	105	78	87	326	72	126	814	337	593
1:45 - 2:00	82	87	84	84	331	79	102	90	90	594
2:00 - 2:15	91	97	67	85	336	75	125	94	98	607
2:15 - 2:30	97	84	80	87	343	88	109	87	95	620
2:30 - 2:45	110	114	106	110	366	100	101	87	96	379
2:45 - 3:00	107	119	92	106	388	87	120	74	94	382
Peak Hour Total	326	300	310	312		389	349	356		365
PHF	0.97	0.88	0.89	0.91		0.88	0.86	0.95		0.90
PM										
4:00 - 4:15	106	136	101	114		96	108	102	102	
4:15 - 4:30	110	116	115	114		86	101	101	96	
4:30 - 4:45	115	86	80	94		112	107	80	100	
4:45 - 5:00	118	133	96	116	437	106	120	110	112	410
5:00 - 5:15	111	118	99	109	432	114	135	89	113	420
5:15 - 5:30	117	117	87	107	426	101	100	85	95	420
5:30 - 5:45	99	113	130	114	446	83	144	95	107	427
5:45 - 6:00	113	111	131	118	449	103	134	115	117	433
6:00 - 6:15	119	126	123	123	462	85	99	102	95	415
6:15 - 6:30	108	116	97	107	462	128	125	101	118	438
6:30 - 6:45	103	107	101	104	452	99	101	101	100	431
6:45 - 7:00	100	102	100	101	434	91	137	110	113	426
Peak Hour Total	440	459	447	449		401	513	384		433
PHF	0.94	0.97	0.85	0.92		0.88	0.89	0.83		0.87

Charleston ATR June 2011	Bloomingdale Rd SB North of Sharrots Rd				Bloomingdale Rd SB North of Amboy Ave			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	112		112		128	84	106	
12:15 - 12:30	124		124		141	77	109	
12:30 - 12:45	123		123		121	92	107	
12:45 - 1:00	114		114	473	105	97	101	423
1:00 - 1:15	117		117	478	103	113	108	425
1:15 - 1:30	89		89	443	108	89	99	414
1:30 - 1:45	106		106	426	118	95	107	414
1:45 - 2:00	116		116	428	115	108	112	425
2:00 - 2:15	114		114	425	131	96	114	430
2:15 - 2:30	111		111	447	113	85	99	431
2:30 - 2:45	121		121	462	126	94	110	434
2:45 - 3:00	92		92	438	101	114	108	430
3:00 - 3:15	123		123	447	99	83	91	408
3:15 - 3:30	90	67	79	415	105	78	92	400
3:30 - 3:45	110	88	99	393	85	84	85	375
3:45 - 4:00	114	91	103	403	98	92	95	362
4:00 - 4:15	122	95	109	389	106	85	96	367
4:15 - 4:30	82	75	79	389	109	91	100	375
4:30 - 4:45	104	99	102	391	112	80	96	387
4:45 - 5:00	98	83	91	379	112	80	96	388
5:00 - 5:15	98	93	96	366	117	73	95	387
5:15 - 5:30	84	93	89	376	84	73	79	366
5:30 - 5:45	81	93	87	362	73	78	76	345
5:45 - 6:00	94	91	92.5	364	102	71	87	336
Peak Hour Total	426	0	426		434	394	414	
PHF	0.91	-	0.91		0.92	0.87	0.90	

Charleston ATR June 2011	Bloomingdale Rd NB South of Amboy Ave				Amboy Rd WB East of Bloomingdale Rd			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	44	24	27	32	13	19	13	15
6:45 - 7:00	38	47	30	38	18	22	15	18
7:00 - 7:15	56	52	41	50	39	36	27	34
7:15 - 7:30	61	59	44	55	36	38	33	36
7:30 - 7:45	100	86	61	82	48	35	46	43
7:45 - 8:00	72	94	79	82	55	68	51	58
8:00 - 8:15	85	78	54	72	88	94	51	78
8:15 - 8:30	98	78	60	79	80	80	54	71
8:30 - 8:45	68	84	59	70	65	59	55	60
8:45 - 9:00	69	65	58	64	72	63	55	63
9:00 - 9:15	71	49	64	61	61	53	64	59
9:15 - 9:30	63	76	58	66	49	56	55	53
Peak Hour Total	320	305	231	285	305	296	215	272
PHF	0.82	0.91	0.96	0.90	0.87	0.79	0.98	0.88
MD								
11:00 - 11:15	77	93	85	85	85	85	90	87
11:15 - 11:30	89	61	75	75	82	71	83	79
11:30 - 11:45	107	64	105	92	121	94	95	103
11:45 - 12:00	104	87	86	92	102	78	95	92
12:00 - 12:15	91	92	89	91	117	82	86	95
12:15 - 12:30	118	69	90	92	110	88	109	102
12:30 - 12:45	116	111	98	108	95	57	95	82
12:45 - 1:00	106	83	99	96	87	102	78	89
1:00 - 1:15	101	103	77	94	78	87	88	84
1:15 - 1:30	93	86	86	88	62	110	87	86
1:30 - 1:45	102	108	84	98	62	85	84	77
1:45 - 2:00	104	99	76	93	86	108	70	88
2:00 - 2:15	80	77	88	82	99	108	95	101
2:15 - 2:30	102	88	97	96	104	139	109	117
2:30 - 2:45	111	137	98	115	88	130	110	109
2:45 - 3:00	96	109	81	95	125	159	100	128
Peak Hour Total	431	355	376	387	409	329	368	369
PHF	0.91	0.80	0.95	0.89	0.87	0.81	0.84	0.84
PM								
4:00 - 4:15	109	114	101	108	119	143	123	128
4:15 - 4:30	89	98	104	97	96	106	79	94
4:30 - 4:45	86	105	102	98	88	124	94	102
4:45 - 5:00	106	102	92	100	102	123	93	106
5:00 - 5:15	101	99	100	100	97	119	72	96
5:15 - 5:30	120	105	99	108	106	119	88	104
5:30 - 5:45	115	94	113	107	91	92	71	85
5:45 - 6:00	107	97	95	100	78	99	100	92
6:00 - 6:15	94	90	129	104	90	97	86	91
6:15 - 6:30	99	86	91	92	84	96	76	85
6:30 - 6:45	95	71	87	84	68	96	101	88
6:45 - 7:00	102	90	116	103	97	82	90	90
Peak Hour Total	443	395	407	415	372	429	331	377
PHF	0.92	0.94	0.90	0.92	0.88	0.90	0.83	0.87

Charleston ATR June 2011	Bloomingdale Rd NB South of Amboy Ave				Amboy Rd WB East of Bloomingdale Rd			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	117	117	117		103	109	106	
12:15 - 12:30	135	103	119		73	109	91	
12:30 - 12:45	129	103	116		104	116	110	
12:45 - 1:00	136	110	123	475	90	92	91	398
1:00 - 1:15	127	126	127	485	106	103	105	397
1:15 - 1:30	120	100	110	476	96	84	90	396
1:30 - 1:45	120	124	122	482	113	92	103	388
1:45 - 2:00	125	107	116	475	102	95	99	396
2:00 - 2:15	117	113	115	463	77	81	79	370
2:15 - 2:30	130	120	125	478	87	84	86	366
2:30 - 2:45	127	110	119	475	85	84	85	348
2:45 - 3:00	114	110	112	471	83	58	71	320
3:00 - 3:15	108	107	108	463	79	49	64	305
3:15 - 3:30	109	120	115	453	80	43	62	281
3:30 - 3:45	107	106	107	441	89	42	66	262
3:45 - 4:00	114	105	110	438	91	71	81	272
4:00 - 4:15	109	105	107	438	77	83	80	288
4:15 - 4:30	120	92	106	429	89	61	75	302
4:30 - 4:45	113	89	101	424	82	65	74	310
4:45 - 5:00	97	93	95	409	86	53	70	298
5:00 - 5:15	87	79	83	385	80	75	78	296
5:15 - 5:30	94	89	92	371	68	60	64	285
5:30 - 5:45	90	90	90	360	72	60	66	277
5:45 - 6:00	100	73	87	351	65	55	60	268
Peak Hour Total	503	460	482		405	371	388	
PHF	0.92	0.91	0.92		0.90	0.90	0.90	

Charleston ATR June 2011	Page Ave NB *				Page Ave SB			
	South of Richmond Valley Rd				North of Richmond Valley Rd			
	Tues	Wed	Thur	AVG	Tues	Wed	Thur	AVG
AM								
6:30 - 6:45	98	111	108	106	45	56	58	53
6:45 - 7:00	105	120	112	112	75	74	72	74
7:00 - 7:15	127	113	116	119	86	69	79	78
7:15 - 7:30	134	144	143	140	78	87	103	89
7:30 - 7:45	142	165	149	152	109	97	120	109
7:45 - 8:00	189	200	157	182	142	151	114	136
8:00 - 8:15	225	202	146	191	117	106	96	106
8:15 - 8:30	226	210	156	197	92	124	83	100
8:30 - 8:45	182	183	159	175	100	94	124	106
8:45 - 9:00	185	167	142	165	105	90	87	94
9:00 - 9:15	154	160	169	161	98	125	102	108
9:15 - 9:30	166	143	144	151	106	113	96	105
Peak Hour Total	818	762	603	728	414	414	390	406
PHF	0.90	0.91	0.95	0.92	0.88	0.83	0.79	0.84
MD								
11:00 - 11:15	150	138	150	146	138	124	108	123
11:15 - 11:30	172	140	171	161	122	88	99	103
11:30 - 11:45	185	150	176	170	128	120	145	131
11:45 - 12:00	207	158	202	189	131	135	144	137
12:00 - 12:15	204	176	201	194	120	109	126	118
12:15 - 12:30	194	159	160	171	128	140	139	136
12:30 - 12:45	199	191	167	186	136	134	162	144
12:45 - 1:00	176	160	178	171	162	143	159	155
1:00 - 1:15	164	181	150	165	128	150	152	143
1:15 - 1:30	181	162	158	167	118	138	142	133
1:30 - 1:45	163	169	167	166	133	150	110	131
1:45 - 2:00	158	153	179	163	116	137	126	126
2:00 - 2:15	165	165	165	165	138	157	130	142
2:15 - 2:30	180	154	176	170	148	144	140	144
2:30 - 2:45	179	193	237	203	112	125	126	121
2:45 - 3:00	183	201	140	175	122	144	127	131
Peak Hour Total	773	686	706	722	546	526	586	553
PHF	0.95	0.90	0.88	0.91	0.84	0.92	0.90	0.89
PM								
4:00 - 4:15	196	180	165	180	126	175	145	149
4:15 - 4:30	159	178	151	163	166	170	138	158
4:30 - 4:45	165	178	150	164	185	172	135	164
4:45 - 5:00	197	181	161	180	184	197	150	177
5:00 - 5:15	177	179	170	175	141	153	159	151
5:15 - 5:30	148	169	175	164	142	151	156	150
5:30 - 5:45	190	146	153	163	141	128	154	141
5:45 - 6:00	155	147	177	160	165	184	190	180
6:00 - 6:15	176	181	194	184	179	168	165	171
6:15 - 6:30	166	164	178	169	135	180	166	160
6:30 - 6:45	139	148	145	144	152	171	182	168
6:45 - 7:00	160	153	166	160	148	165	188	167
Peak Hour Total	670	641	675	662	589	616	659	621
PHF	0.88	0.90	0.95	0.91	0.89	0.84	0.87	0.87

*Note - Median ATR value for AM peak (762) was used in
balancing network to avoid a dramatic reduction of
manual traffic counts

Charleston ATR June 2011	Page Ave NB South of Richmond Valley Rd				Page Ave SB North of Richmond Valley Rd			
	Sat 1	Sat 2	AVG		Sat 1	Sat 2	AVG	
SMD								
12:00 - 12:15	190	209	200		150	157	154	
12:15 - 12:30	220	188	204		173	167	170	
12:30 - 12:45	239	215	227		147	175	161	
12:45 - 1:00	284	219	252	882	177	160	169	653
1:00 - 1:15	286	222	254	937	134	139	137	636
1:15 - 1:30	194	221	208	940	157	160	159	625
1:30 - 1:45	238	186	212	925	159	162	161	624
1:45 - 2:00	221	249	235	909	152	150	151	607
2:00 - 2:15	202	209	206	860	148	165	157	627
2:15 - 2:30	208	190	199	852	153	128	141	609
2:30 - 2:45	175	180	178	817	164	153	159	607
2:45 - 3:00	197	197	197	779	138	150	144	600
3:00 - 3:15	181	162	172	745	137	135	136	579
3:15 - 3:30	164	190	177	723	150	145	148	586
3:30 - 3:45	168	180	174	720	149	160	155	582
3:45 - 4:00	157	160	159	681	167	155	161	599
4:00 - 4:15	171	162	167	676	145	153	149	612
4:15 - 4:30	190	162	176	675	152	140	146	611
4:30 - 4:45	165	153	159	660	148	145	147	603
4:45 - 5:00	166	171	169	670	147	139	143	585
5:00 - 5:15	157	163	160	664	148	129	139	574
5:15 - 5:30	176	176	176	664	160	136	148	576
5:30 - 5:45	164	138	151	656	123	135	129	559
5:45 - 6:00	170	125	148	635	146	123	135	550
Peak Hour Total	1002	848	925		627	621	624	
PHF	0.88	0.95	0.92		0.89	0.96	0.92	

Charleston ATR June 2011	Peak Hour Totals for All Intersections	
	AVG	
AM		
6:30 - 6:45	635	
6:45 - 7:00	777	
7:00 - 7:15	872	
7:15 - 7:30	2511	4795
7:30 - 7:45	2861	7021
7:45 - 8:00	3244	9488
8:00 - 8:15	3519	12134
8:15 - 8:30	3639	13262
8:30 - 8:45	3622	14023
8:45 - 9:00	3495	14274
9:00 - 9:15	3469	14225
9:15 - 9:30	3388	13974
Peak Hour Total		14274
PHF		0.98
MD		
11:00 - 11:15	1505	
11:15 - 11:30	1496	
11:30 - 11:45	1561	
11:45 - 12:00	4107	8669
12:00 - 12:15	4189	11353
12:15 - 12:30	4202	14059
12:30 - 12:45	4288	16787
12:45 - 1:00	4209	16888
1:00 - 1:15	4235	16935
1:15 - 1:30	4159	16891
1:30 - 1:45	4229	16832
1:45 - 2:00	4144	16767
2:00 - 2:15	4158	16689
2:15 - 2:30	4172	16703
2:30 - 2:45	4320	16794
2:45 - 3:00	4371	17022
Peak Hour Total		16888
PHF		0.98
PM		
4:00 - 4:15	1903	
4:15 - 4:30	1663	
4:30 - 4:45	1659	
4:45 - 5:00	4712	9936
5:00 - 5:15	4746	12779
5:15 - 5:30	4749	15865
5:30 - 5:45	4715	18922
5:45 - 6:00	4678	18888
6:00 - 6:15	4652	18795
6:15 - 6:30	4622	18668
6:30 - 6:45	4498	18451
6:45 - 7:00	4545	18318
Peak Hour Total		18795
PHF		0.99

Charleston ATR June 2011	Peak Hour Totals for All Intersections	
	AVG	
SMD		
12:00 - 12:15	1515	
12:15 - 12:30	1562	
12:30 - 12:45	1522	
12:45 - 1:00	4814	9412
1:00 - 1:15	4836	12733
1:15 - 1:30	4900	16071
1:30 - 1:45	4861	19410
1:45 - 2:00	4784	19380
2:00 - 2:15	4744	19289
2:15 - 2:30	4672	19061
2:30 - 2:45	4476	18676
2:45 - 3:00	4344	18236
3:00 - 3:15	4165	17657
3:15 - 3:30	4095	17079
3:30 - 3:45	4144	16747
3:45 - 4:00	4158	16561
4:00 - 4:15	4150	16545
4:15 - 4:30	4116	16566
4:30 - 4:45	4138	16560
4:45 - 5:00	4044	16446
5:00 - 5:15	3924	16221
5:15 - 5:30	3895	16000
5:30 - 5:45	3765	15627
5:45 - 6:00	3746.5	15330
Peak Hour Total		19410
PHF		0.99

Geometry

Project: Charleston Project #: 1121A

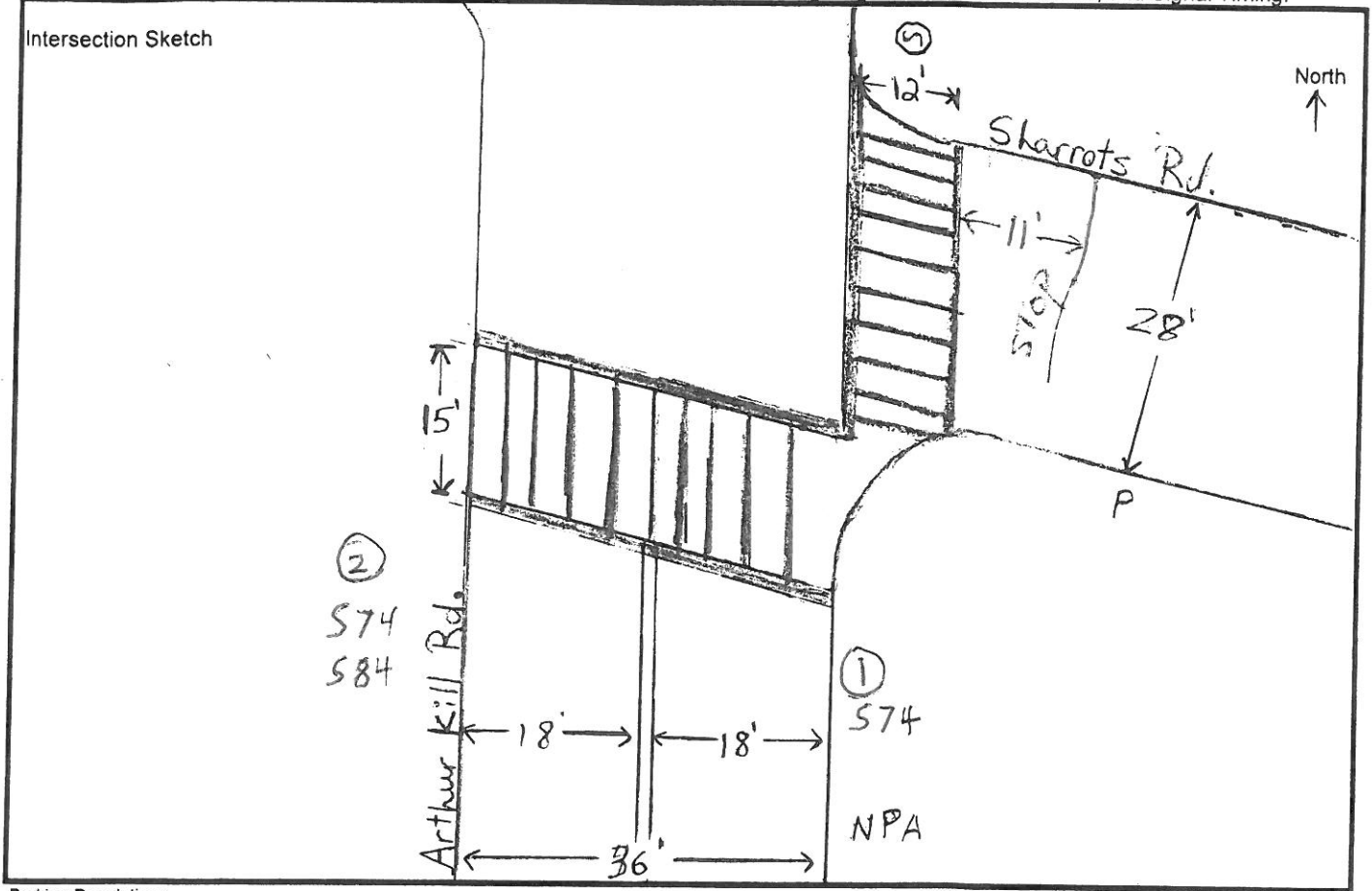
Physical Inventory Sheet

Location: Sharrets Road and Arthur Kill Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

- (1) NB Appr. S 74 stop (bus) No standing ()
- (2) SB Appr. S 74, S 84 bus stop ()
- (P) No regs ()
- () ()
- () ()
- () ()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length	
AM	MD
PM	Sat. MD
Pedestrian Button	
Y	N
Signal Type	
P	A

Project:

Charles-on

Project #:

1121A

Physical Inventory Sheet

Location:

Sharrots Rd + Arthur Kill Rd

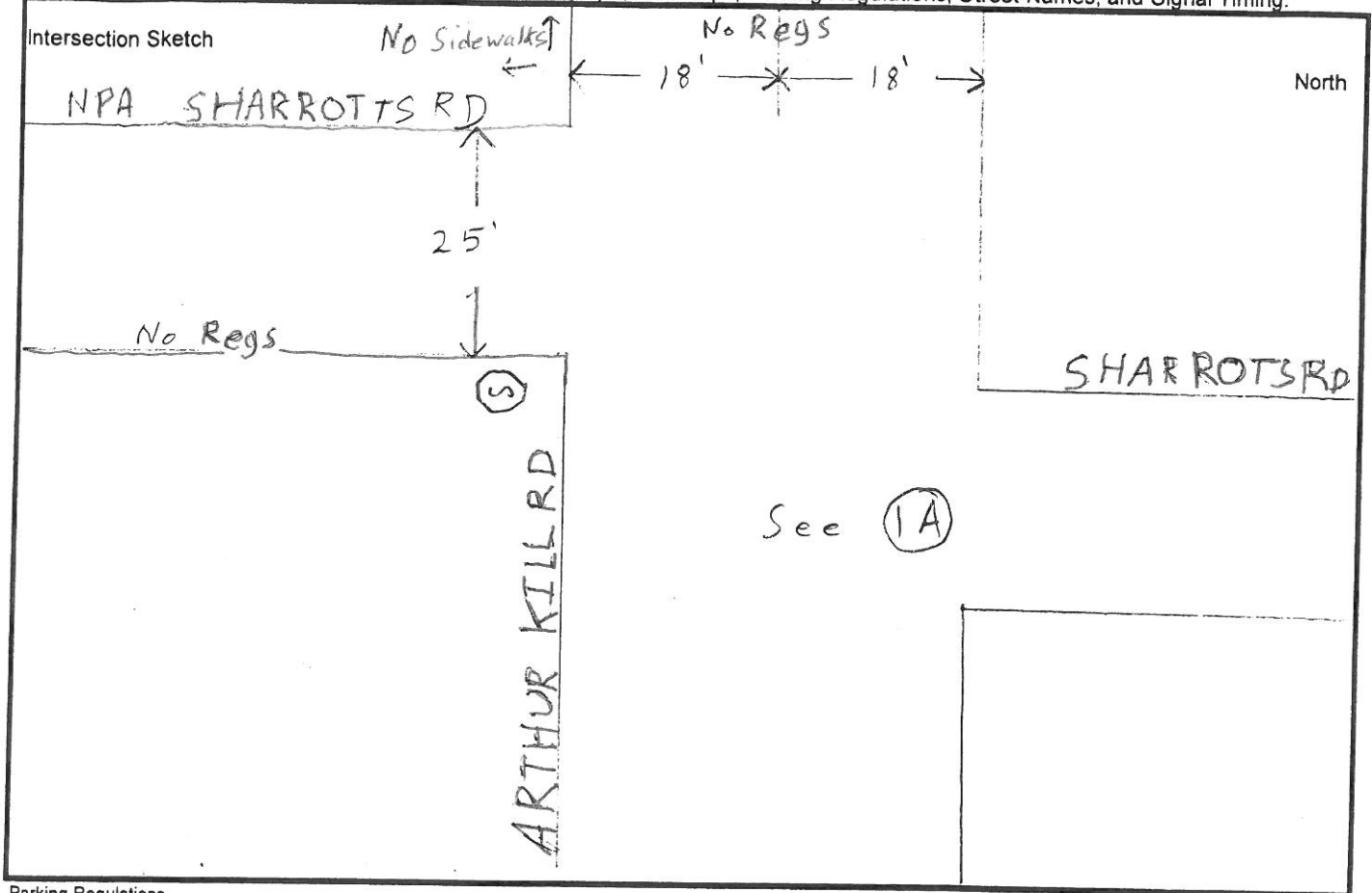
Date:

Weather:

Surveyor:

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

()	()
()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

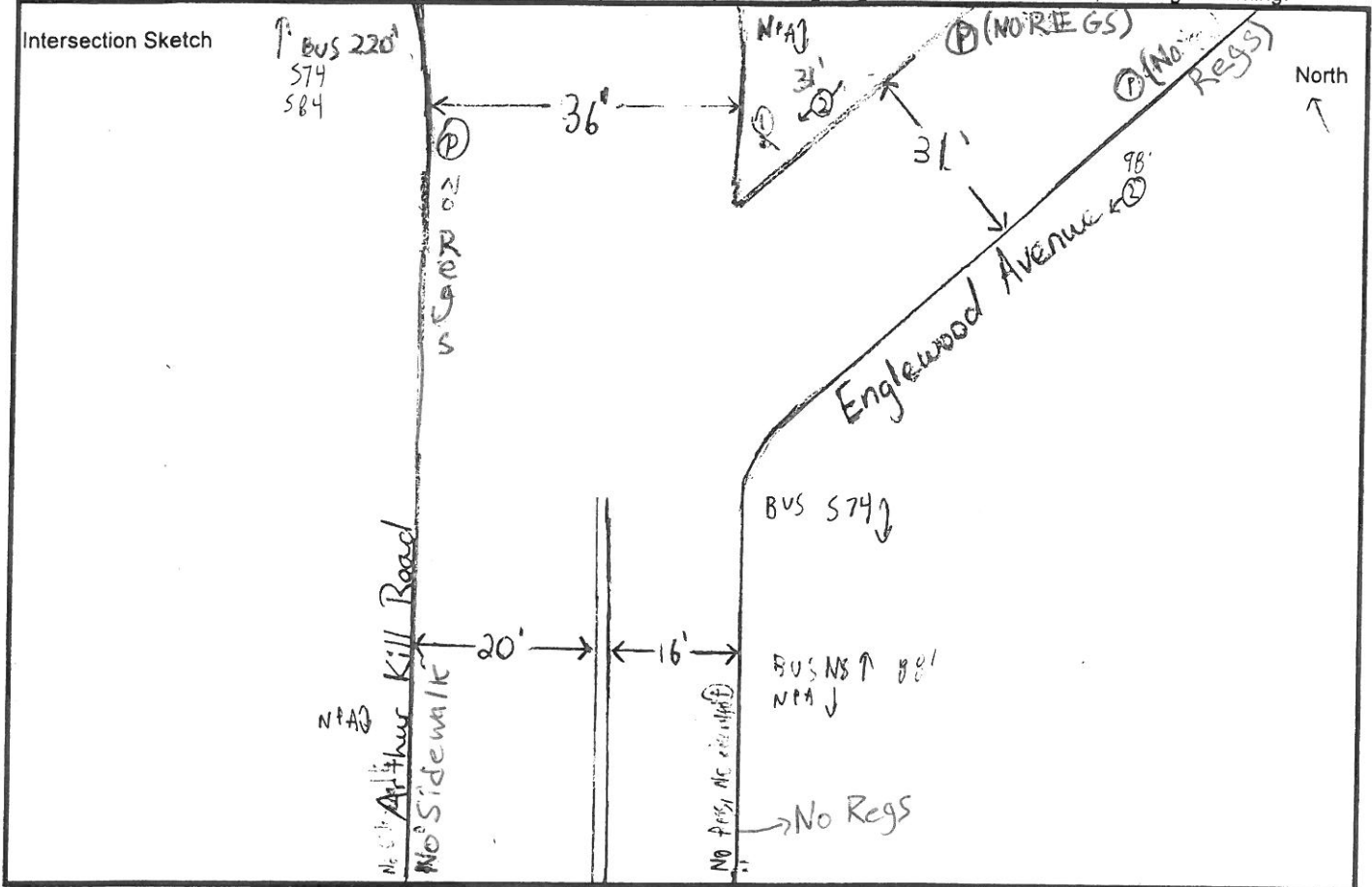
P	A
---	---

Project: Charleston Project #: 1121A

Location: Arthur Kill Road and Englewood Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) STOP	()
(2) NP8A-5P M-F	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

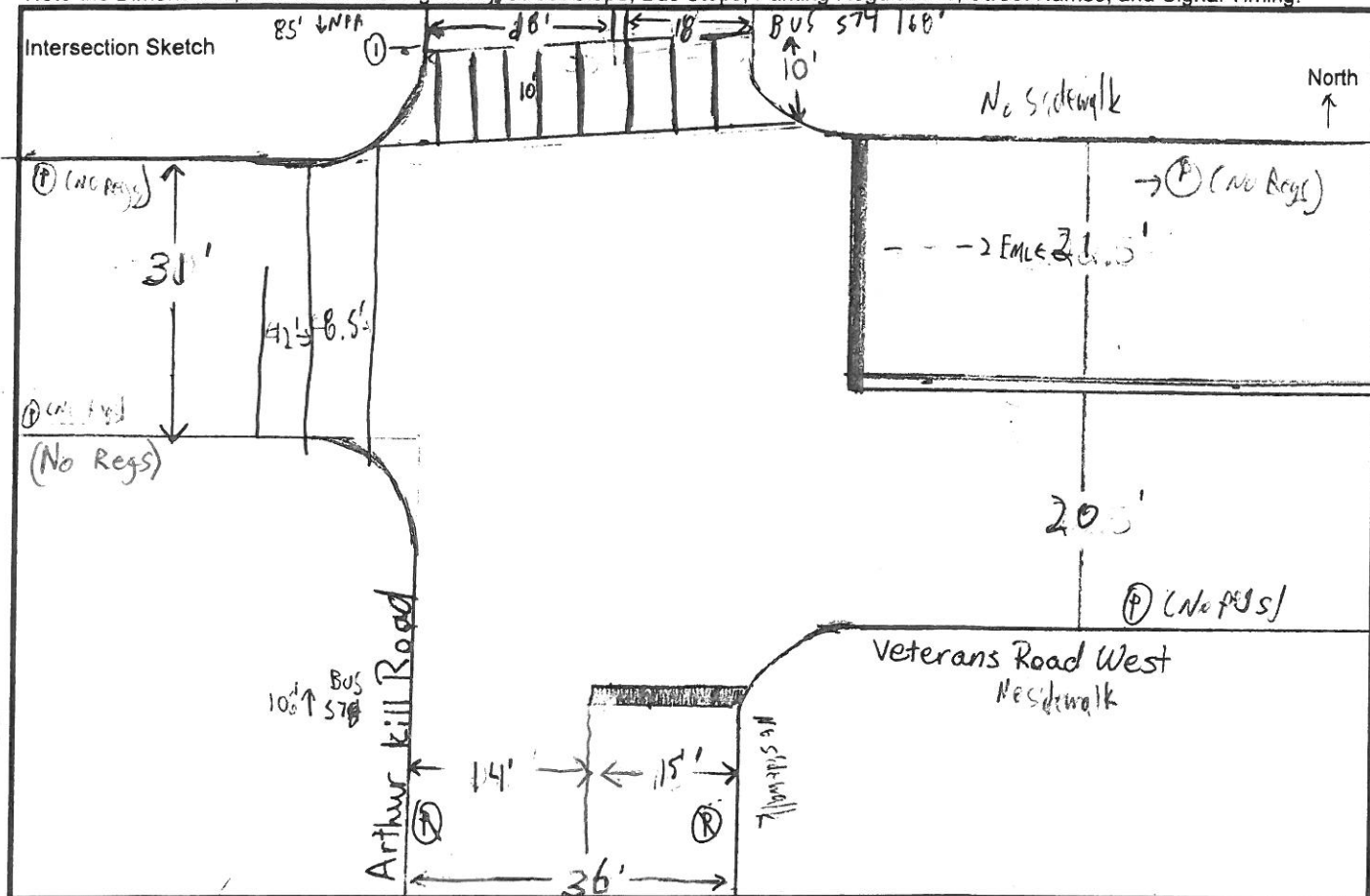
P	A
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Project: Charleston Project #: 11.21.A

Location: Arthur Kill Road and Veterans Road West

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) AFTER STOP RIGHT TURN PERMITTED ON RED	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

P	A
---	---

Cycle Length	
AM	MD
PM	Sat. MD
Pedestrian Button	
Y	N
Signal Type	
P	A

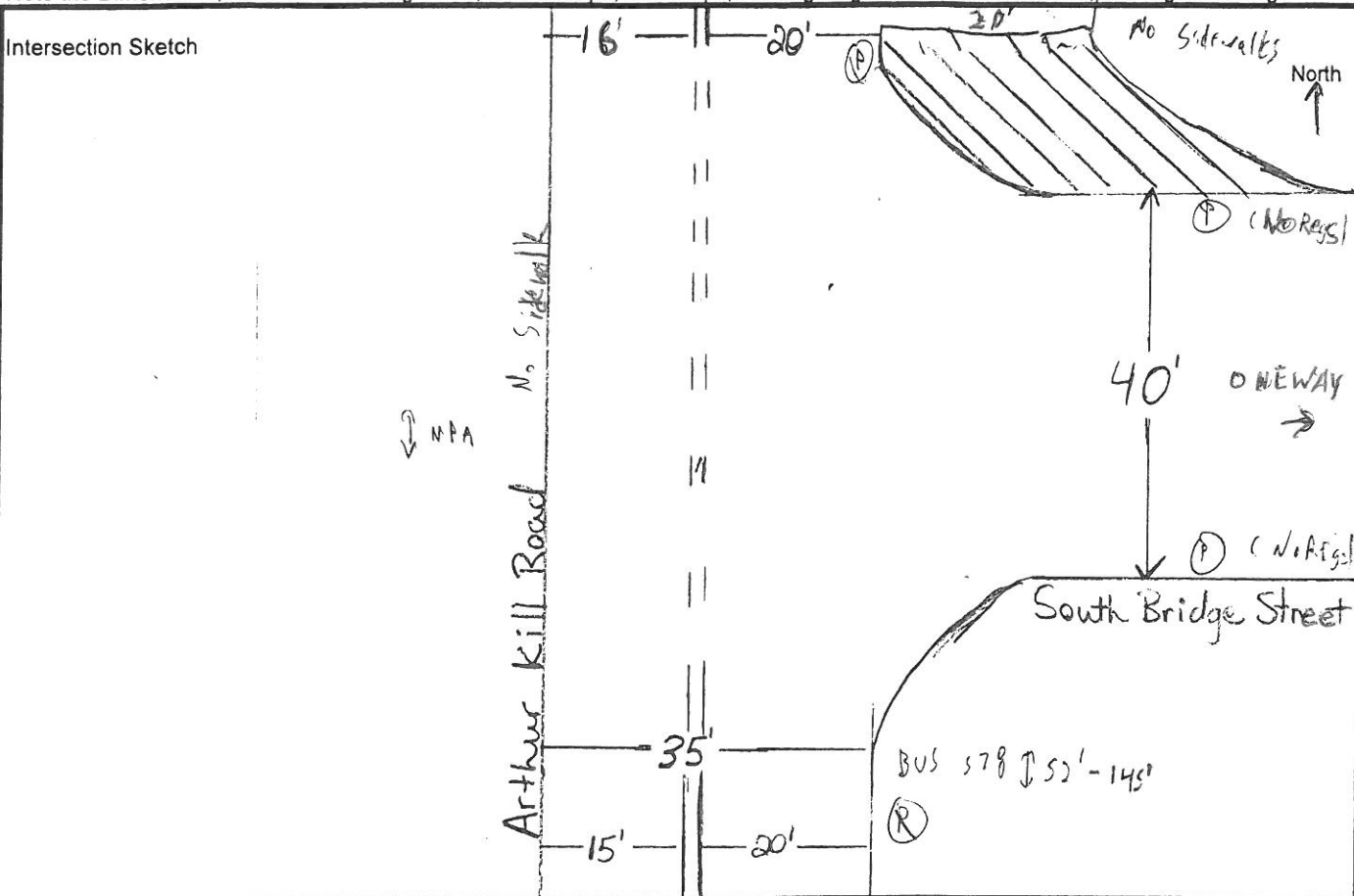
Project: Charleston Project #: 11.01A

Location: Arthur Kill Road and South Bridge Street

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

P	A
---	---

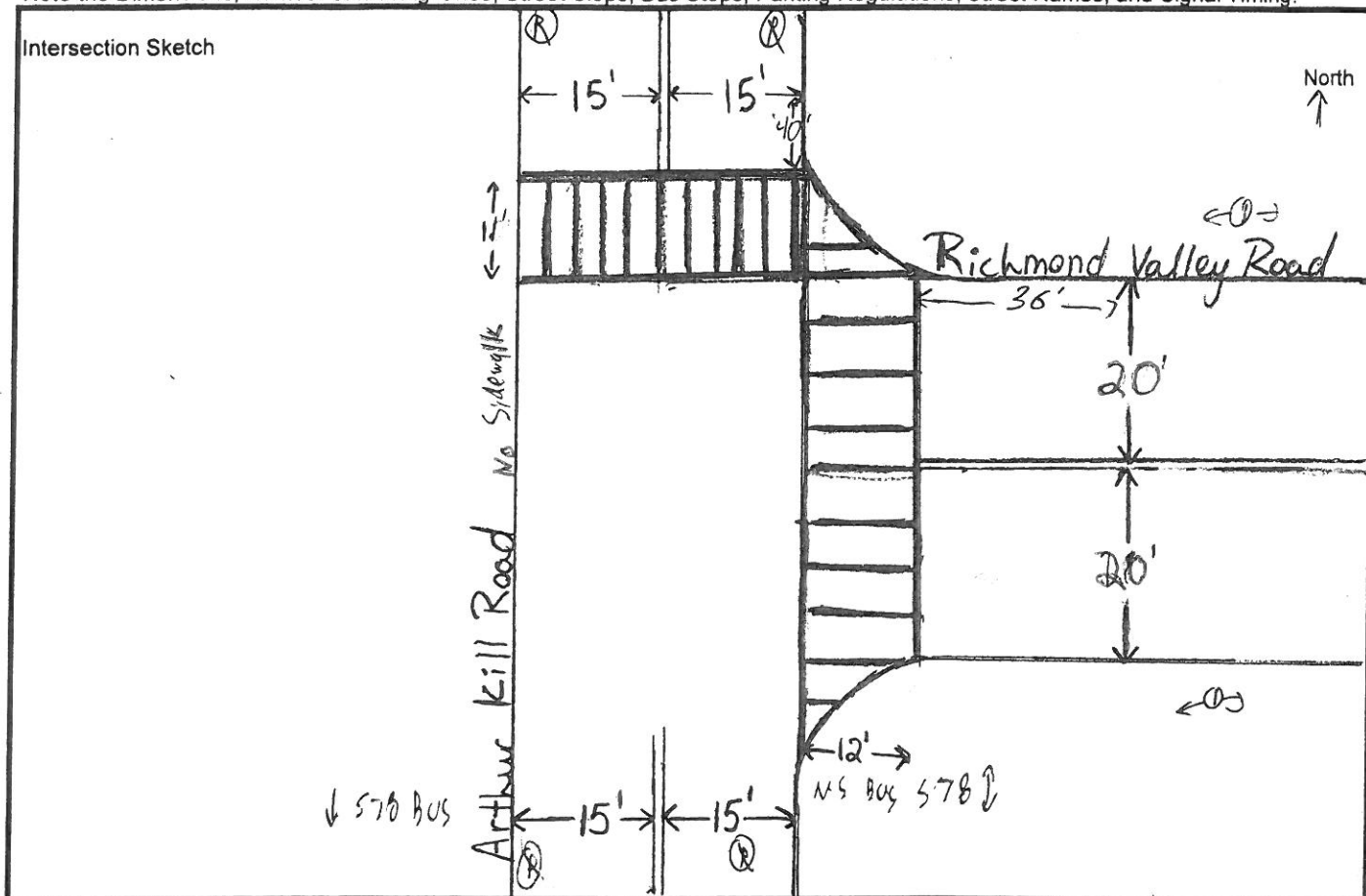
Project: Charleston Project #: 1121A

Location: Arthur Kill Road and Richmond Valley Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

(1) NIGHT REG NS 10P-6A INCL SUN	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

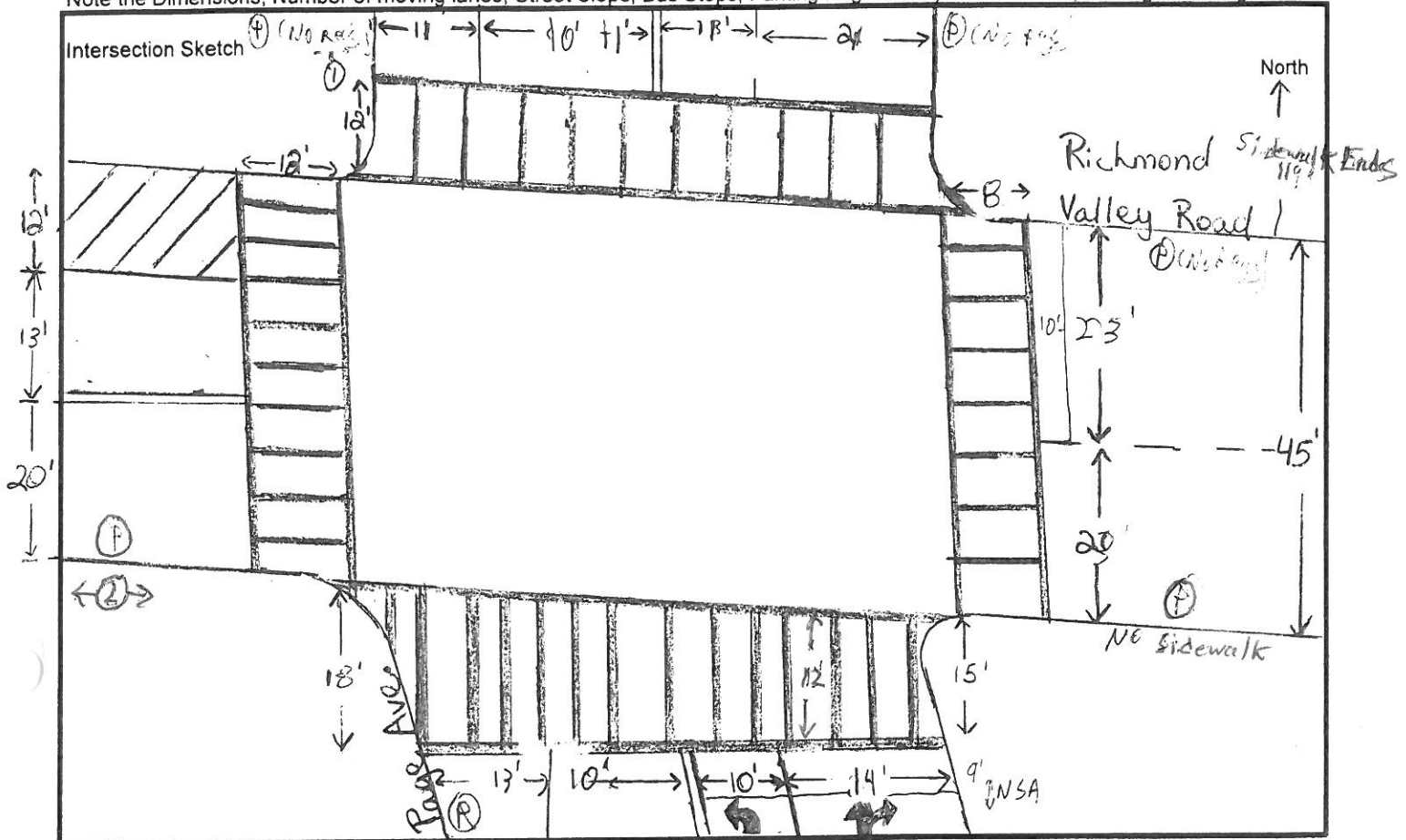
P	A
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Project: Charleston Project #: 1151A

Location: Richmond Valley Road and Page Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

- (1) AFTER STOP RT PERMITTED
- (2) NS 10P-6A NO PARKING
- ()
- ()
- ()
- ()
- ()

ONLY

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

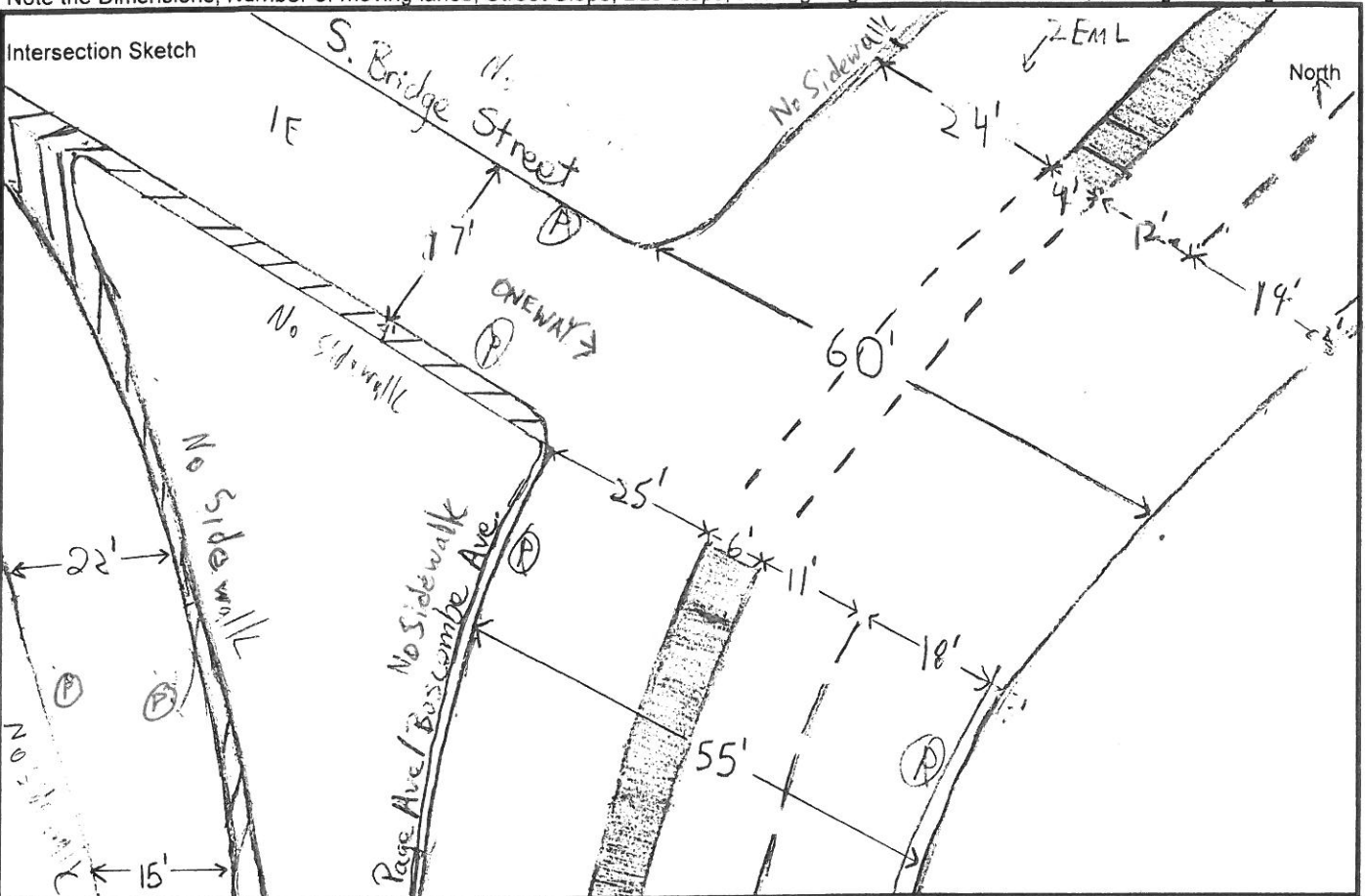
P	A
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Project: Charleston Project #: 1121A

Location: Page Avenue/Boscombe Avenue and S. Bridge Street

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

()	()
()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

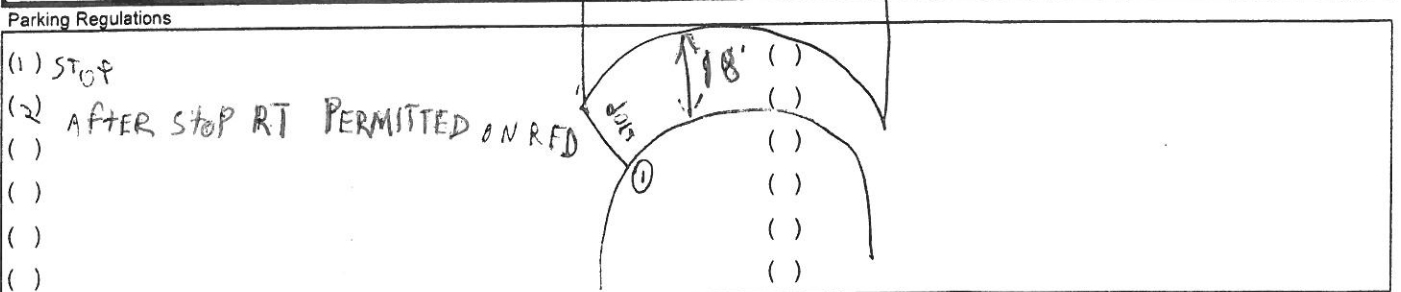
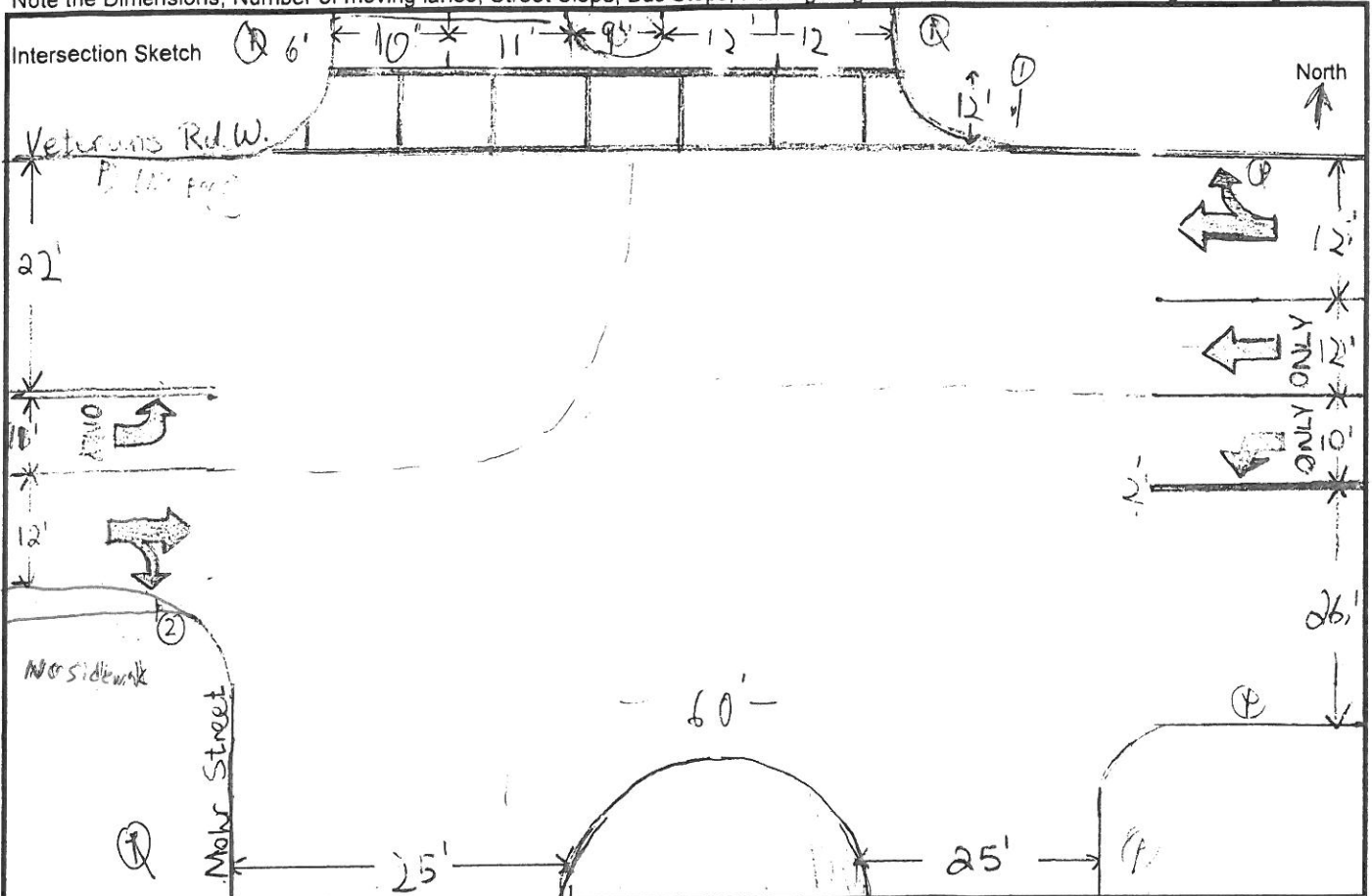
P	A
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Project: Charleston Project #: 1121A

Location: Veterans Road W. and Mohr Street

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Signal Timing		Green Time(Sec.)	Y+AR	Cycle Length	
Approach	Phasing Diagram	AM/MD/PM/Sat. MD		AM	MD
				PM	Sat. MD
				Pedestrian Button	
				Y	N
				Signal Type	
				P	A

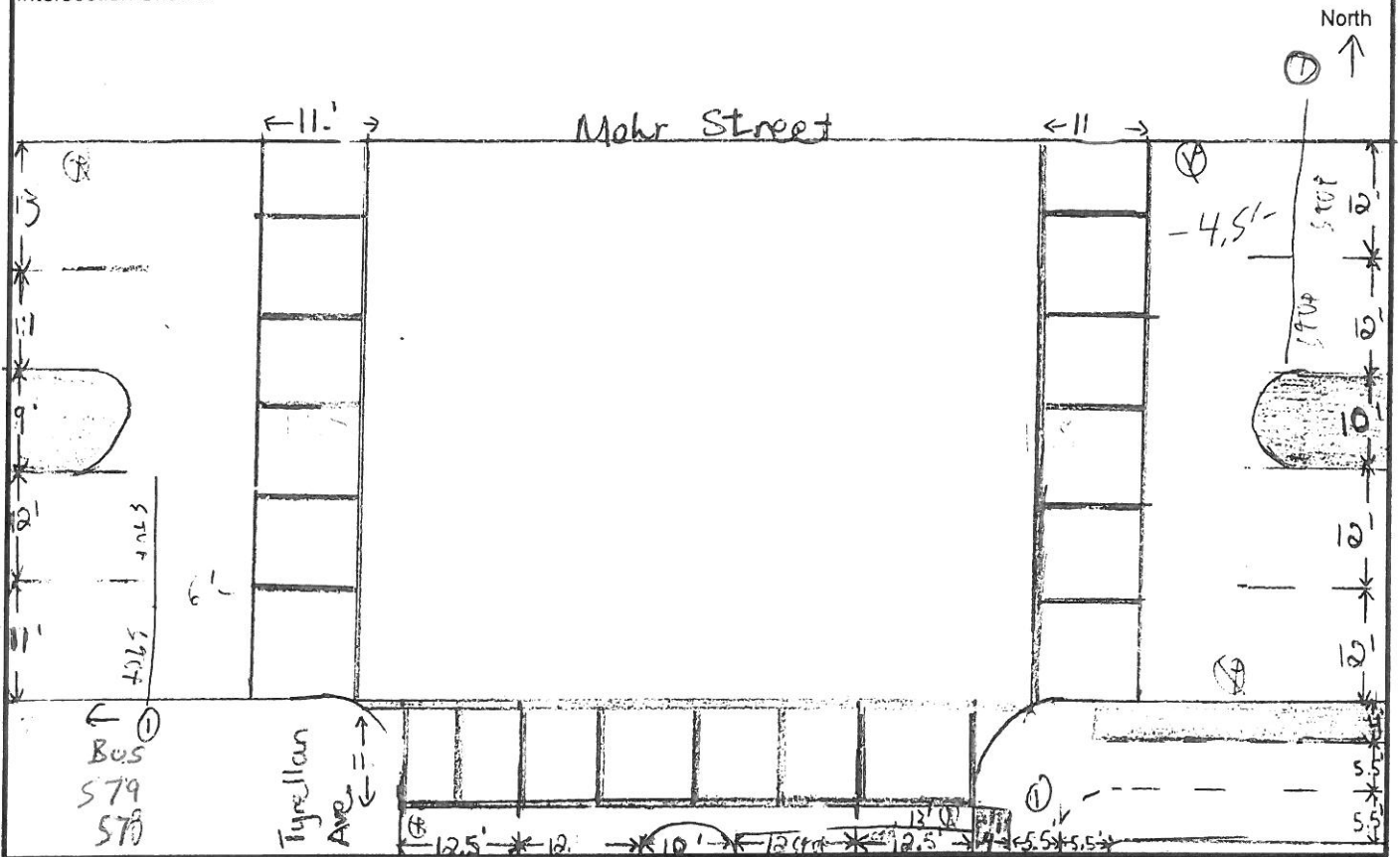
Project: Charleston Project #: 1121.A

Location: Mahr Street and Tynellan Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

(1) Stop 147'	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

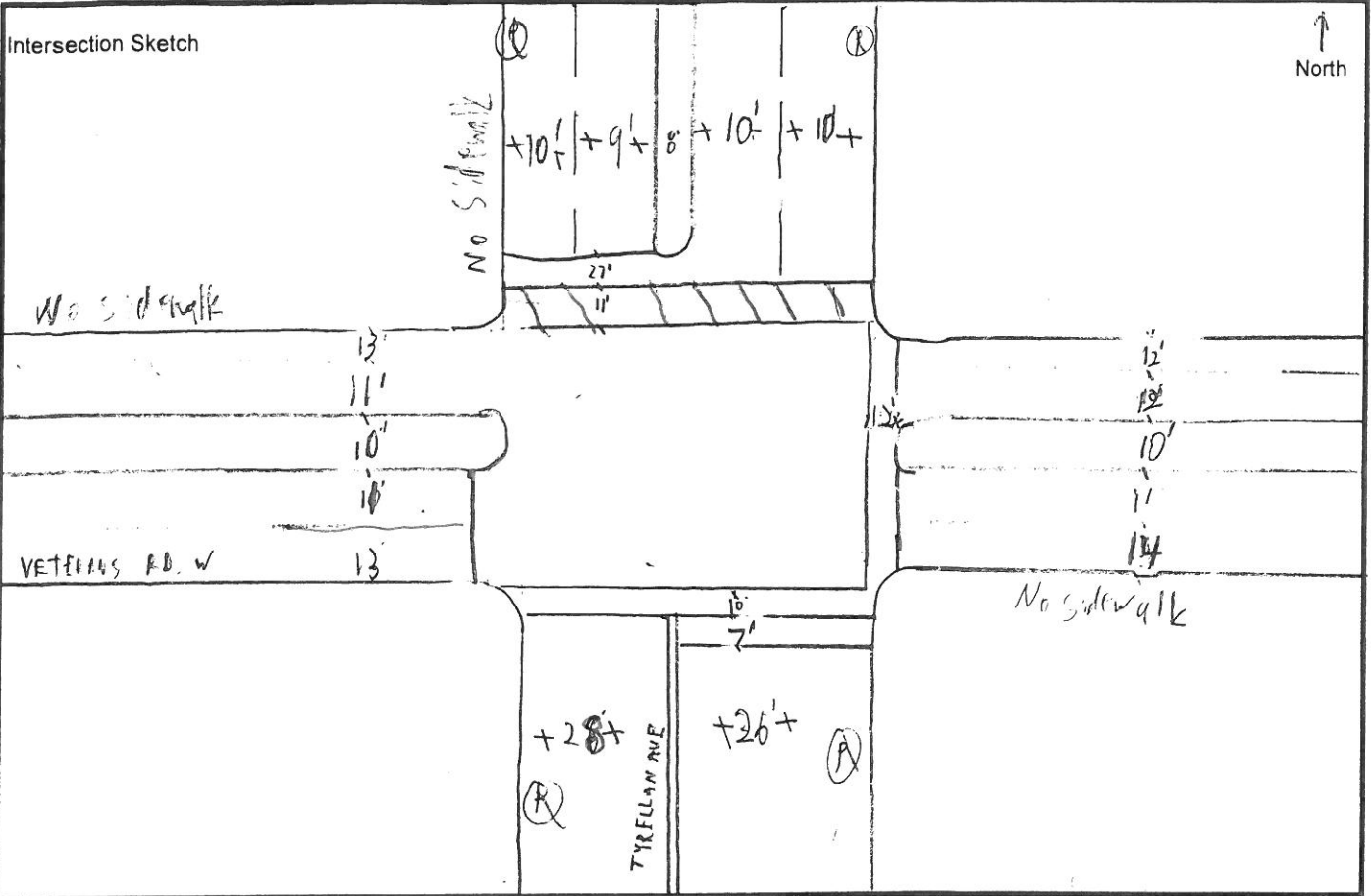
P	A
---	---

Project: Charleston Project #: 11.31.A

Location: Veterans Rd. W @ Tyrellan Ave

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

()	no observed parking (No Regs)	()
()		()
()		()
()		()
()		()
()		()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

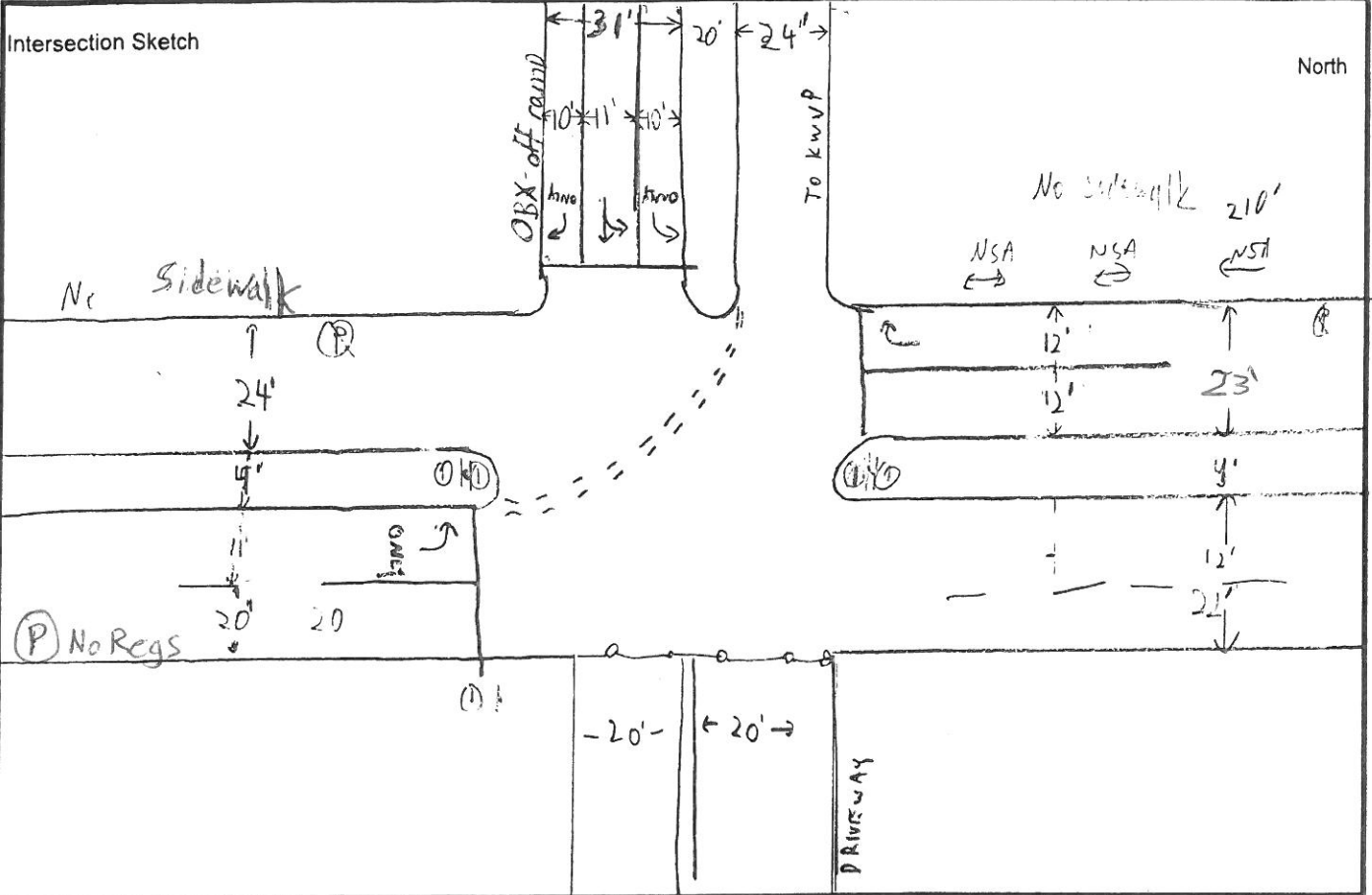
P	A
---	---

Project: Charleston Project #: 1121A

Location: Boscombe Ave @ Outerbridge Crossing off-Ramp

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

- () No Regs, no obstruct parking
- () NO U TURN
- () AFTER STOP RT PERMITTING ON RED
- ()
- ()
- ()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

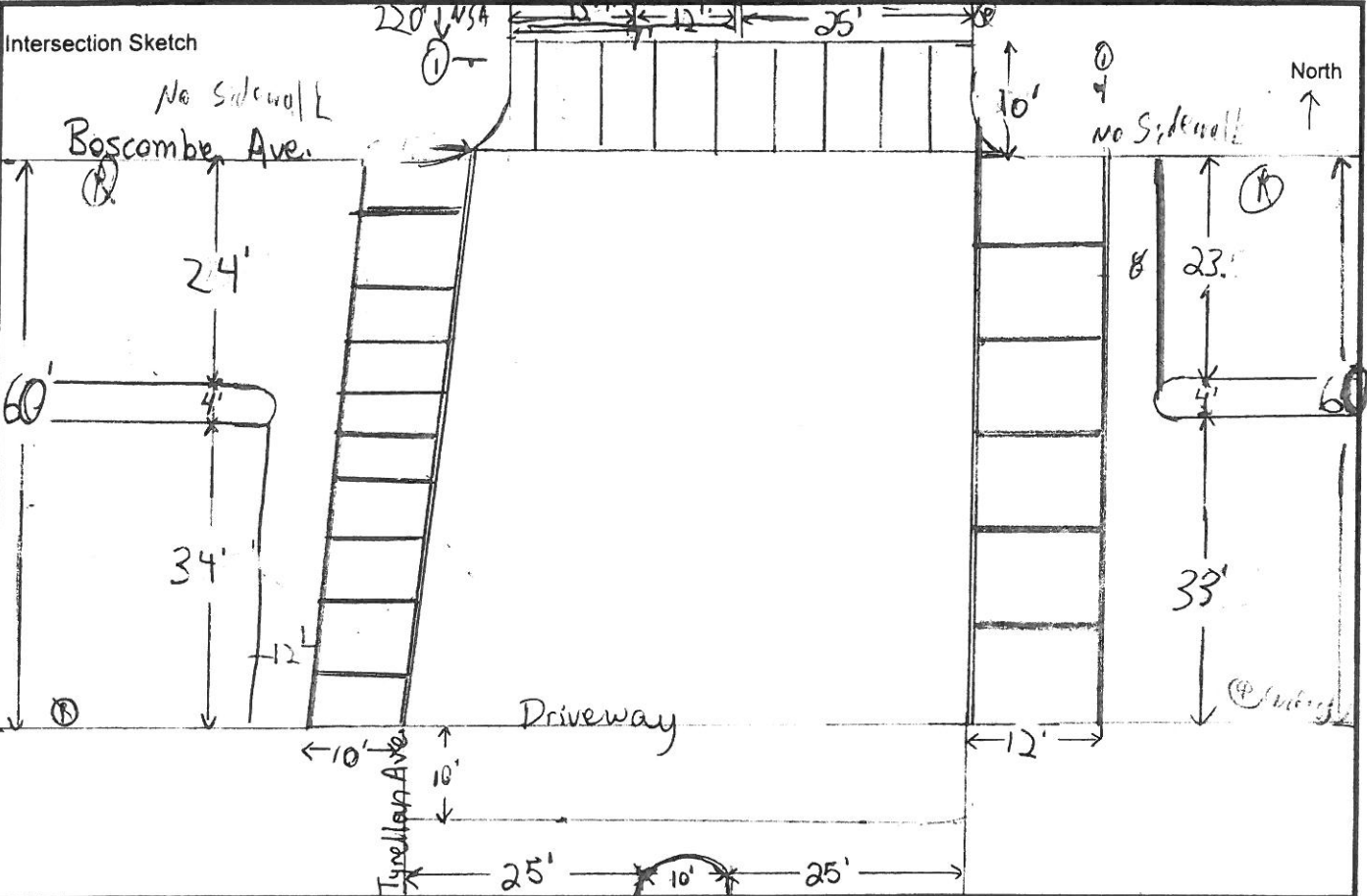
P	A
---	---

Project: Charleston Project #: 1121A

Location: Boscombe Ave. and Tyrellan Ave.

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

- (P) - no regs, observed parking ()
 (1) AFTER STOP RIGHT TURN PERMITTED ON RED ()
 () ()
 () ()
 () ()
 () ()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD
Pedestrian Button	
Y	N
Signal Type	
P	A

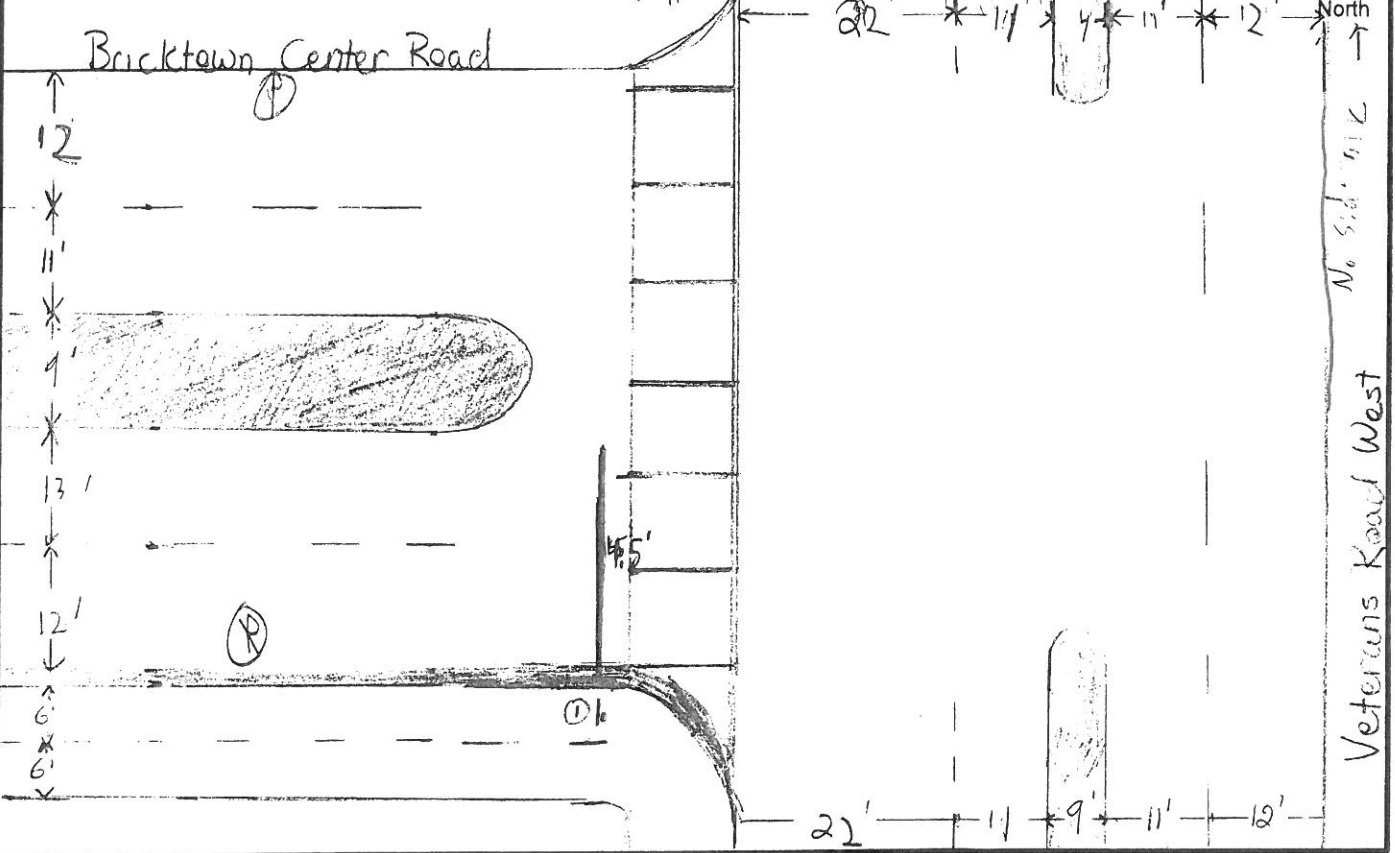
Project: Charleston Project #: 1121A

Location: Veterans Road West and Bricktown Center Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

- (1) AFTER STOP RIGHT TURN PERMITTED ON RED ()
- () NO REGS, NO OBSERVED PARKING ()
- () ()
- () ()
- () ()
- () ()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

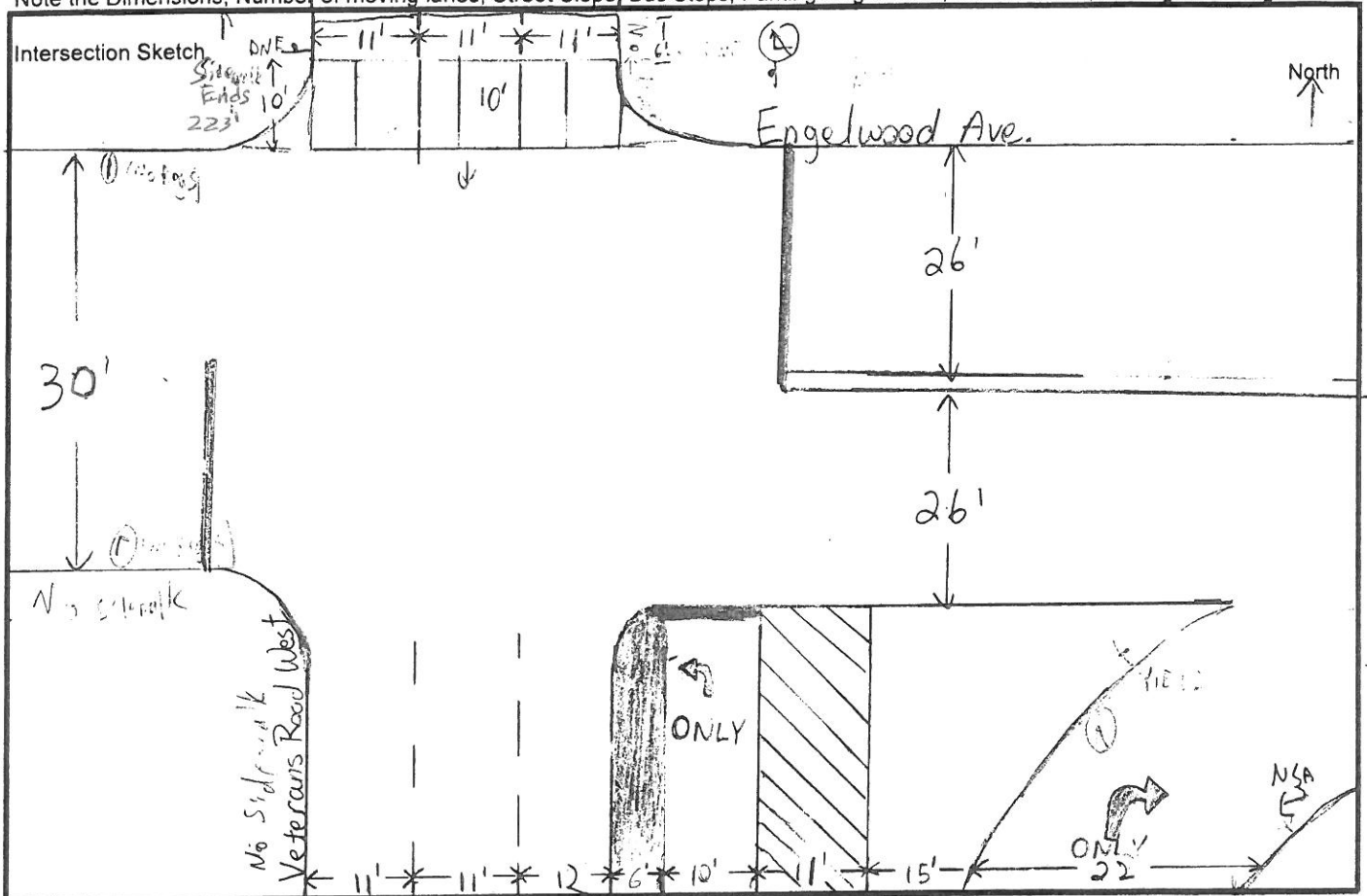
P	A
---	---

Project: Charleston Project #: 11-21A

Location: Veterans Road West and Engelwood Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

()	()
()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

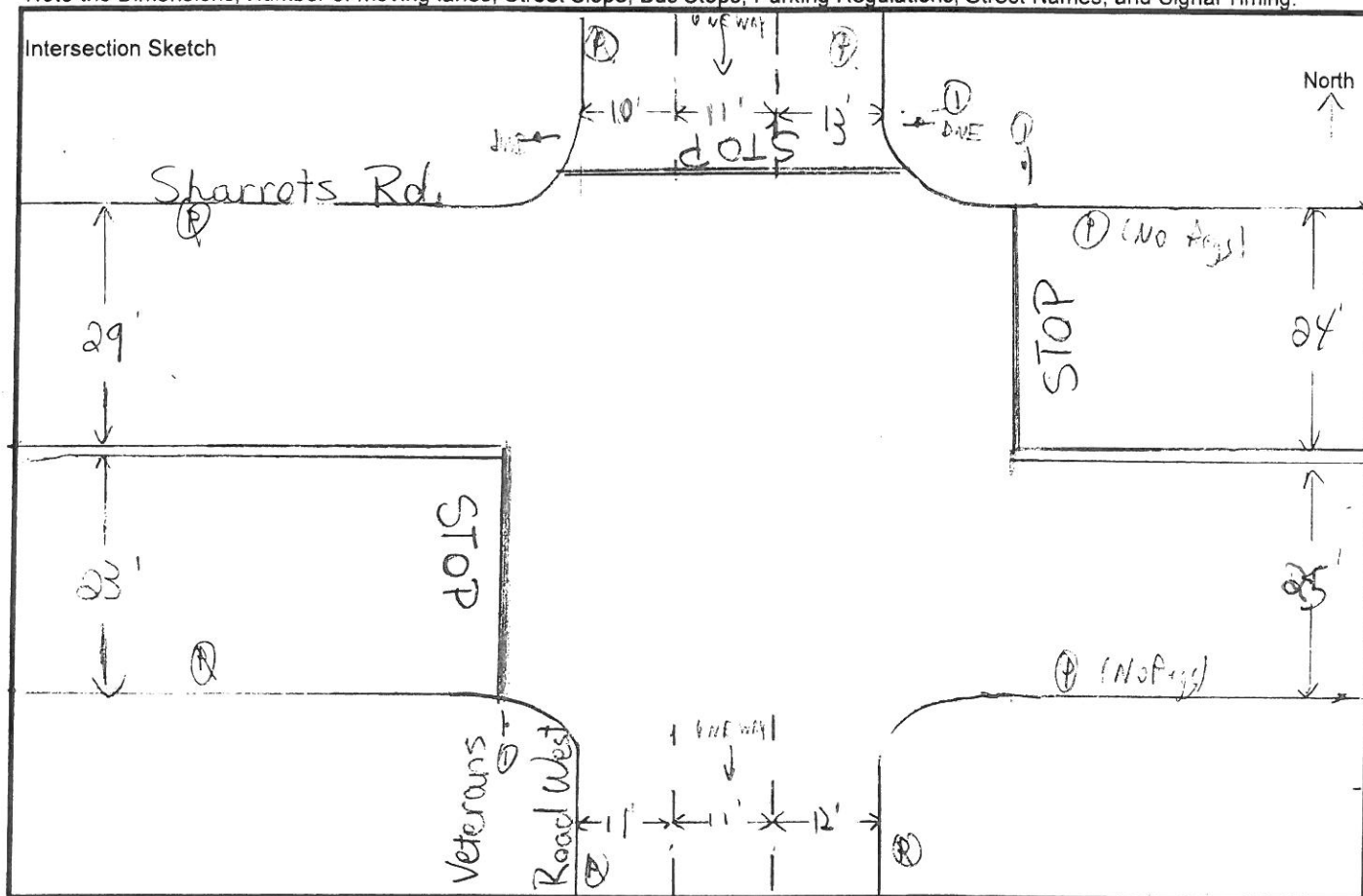
Y	N
---	---

Signal Type

P	A
---	---

Date: Weather: Surveyor:

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

[illegible]

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

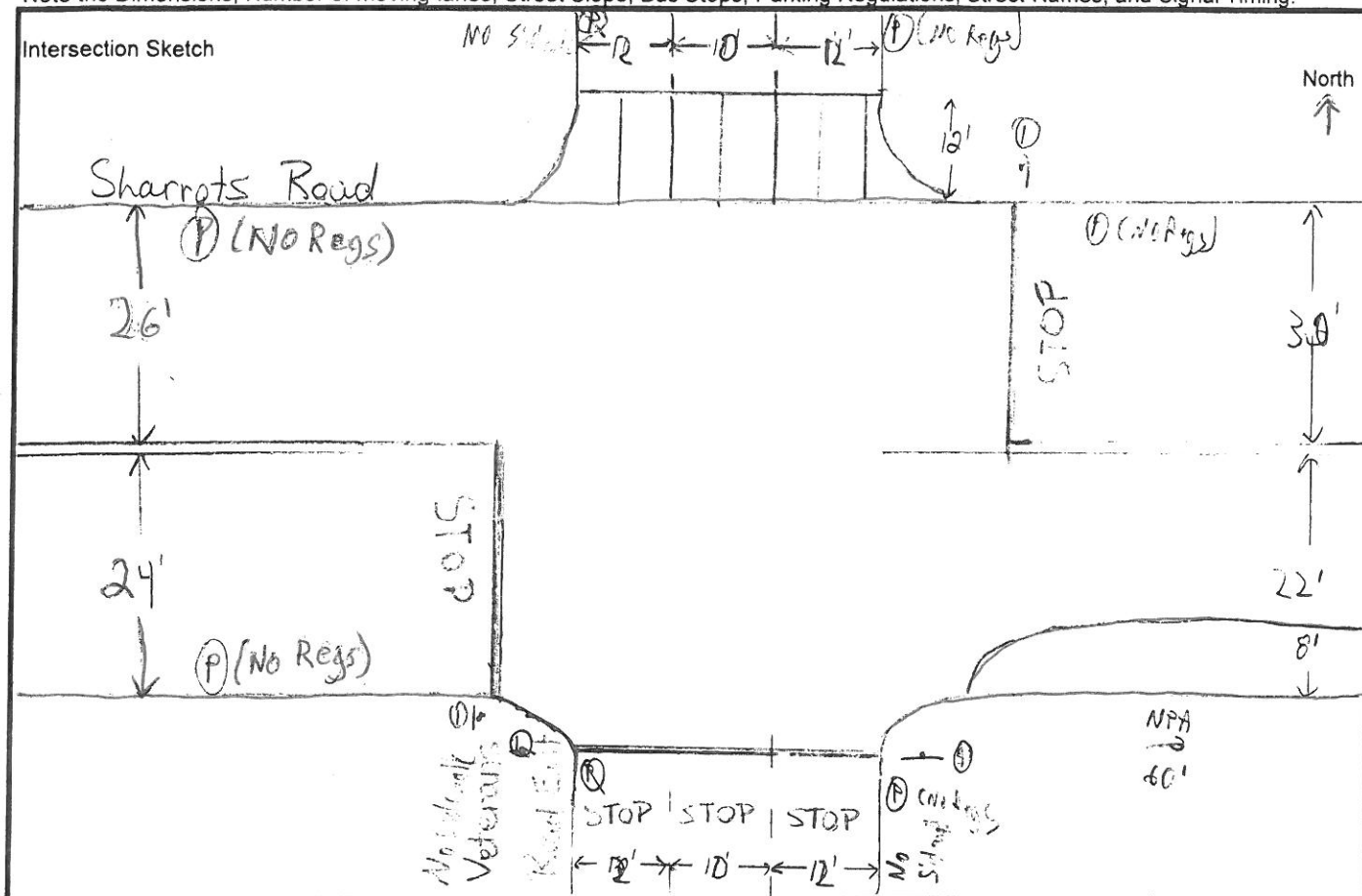
Y	N
---	---

Signal Type

P	A
---	---

Date: Weather: Surveyor:

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

[illegible]

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

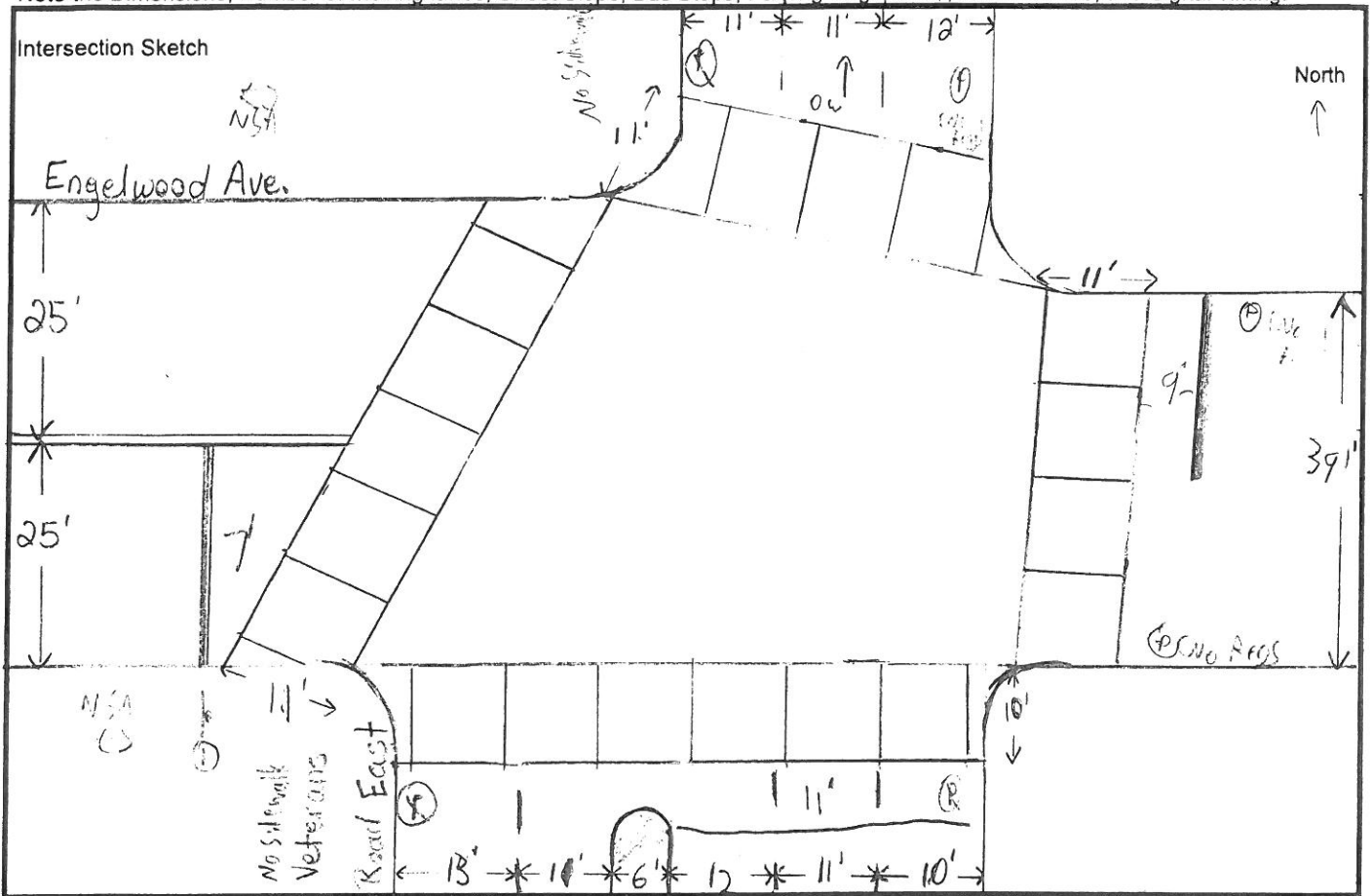
Cycle Length	
AM	MD
PM	Sat. MD
Pedestrian Button	
Y	N
Signal Type	
P	A

Project: Charleston Project #: 1121A

Location: Veterans Road East and Engelwood Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) AFTER STOP RT PERMITTED ON RED	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

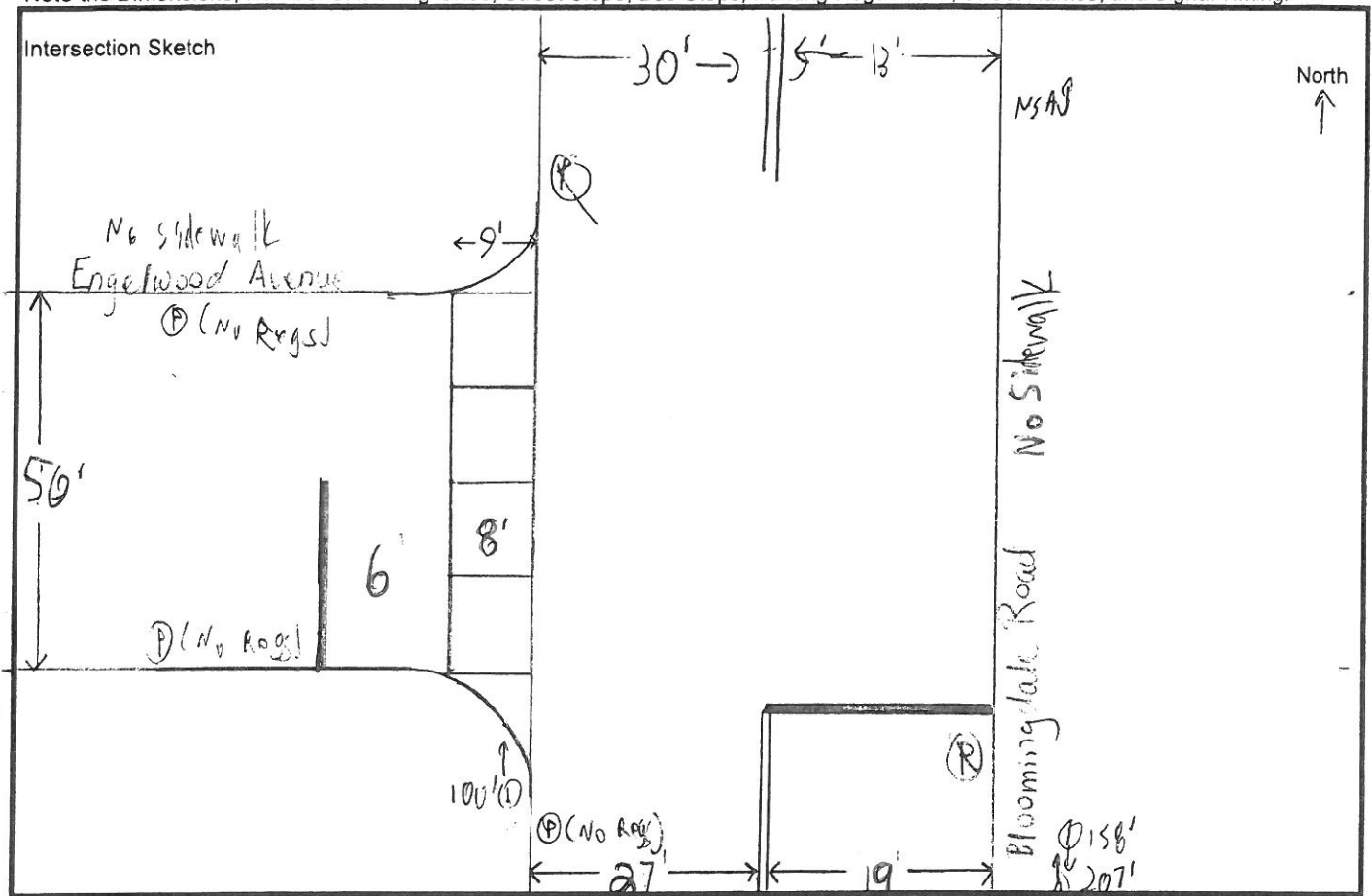
P	A
---	---

Project: Charleston Project #: 1131A

Location: Bloomington Road and Engelwood Avenue

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) NS M-F BUS 555 X 22	()
()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

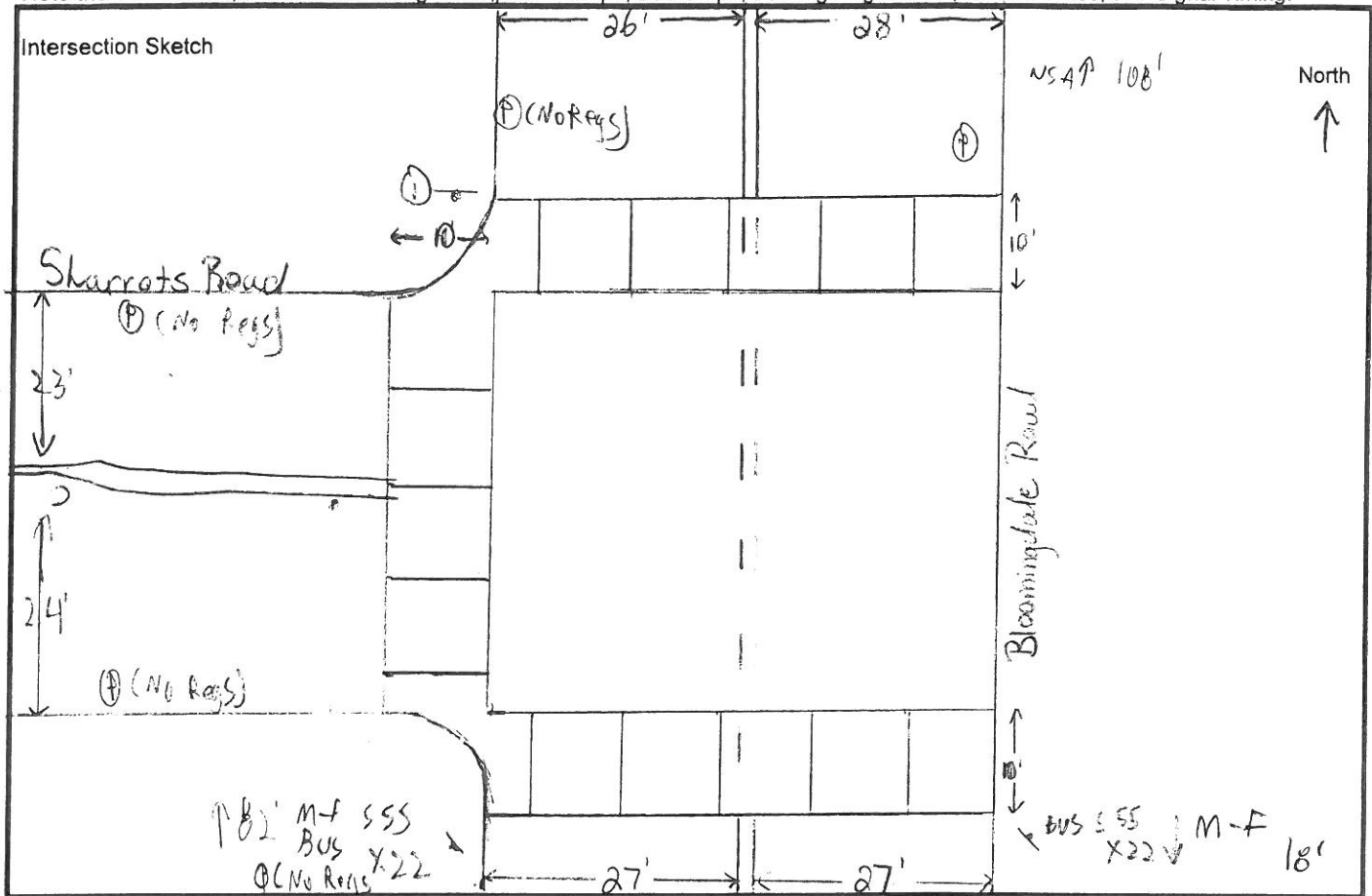
P	A
---	---

Project: Charleston Project #: 11.21.A

Location: Bloomingdale Road and Sharrots Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) AFTER STOP AT PERMITTED ON RED	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

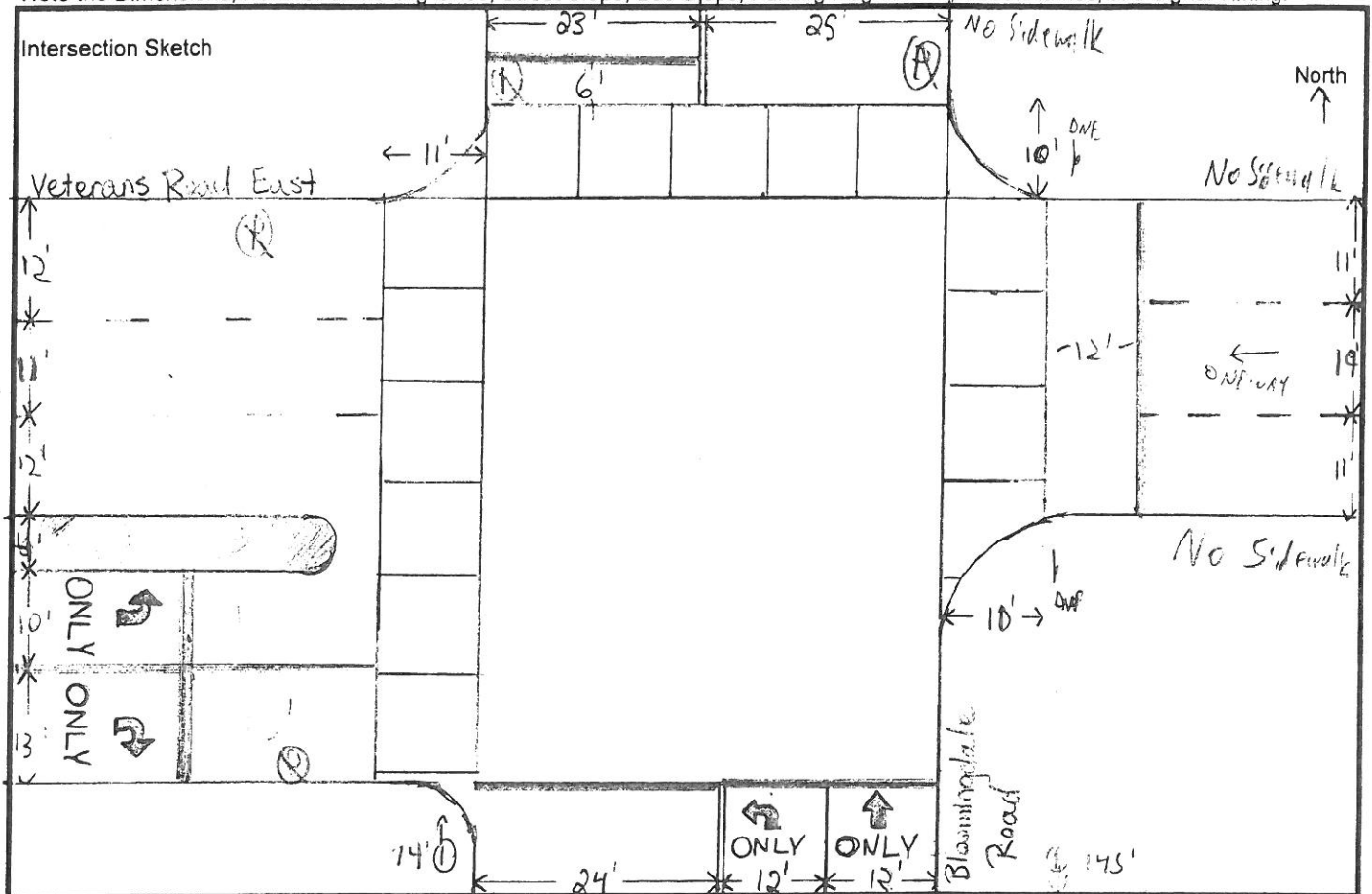
P	A
---	---

Project: Charleston Project #: 1112

Location: Veterans Road East and Bloomingdale Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

()	()
()	()
()	()
()	()
()	()
()	()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

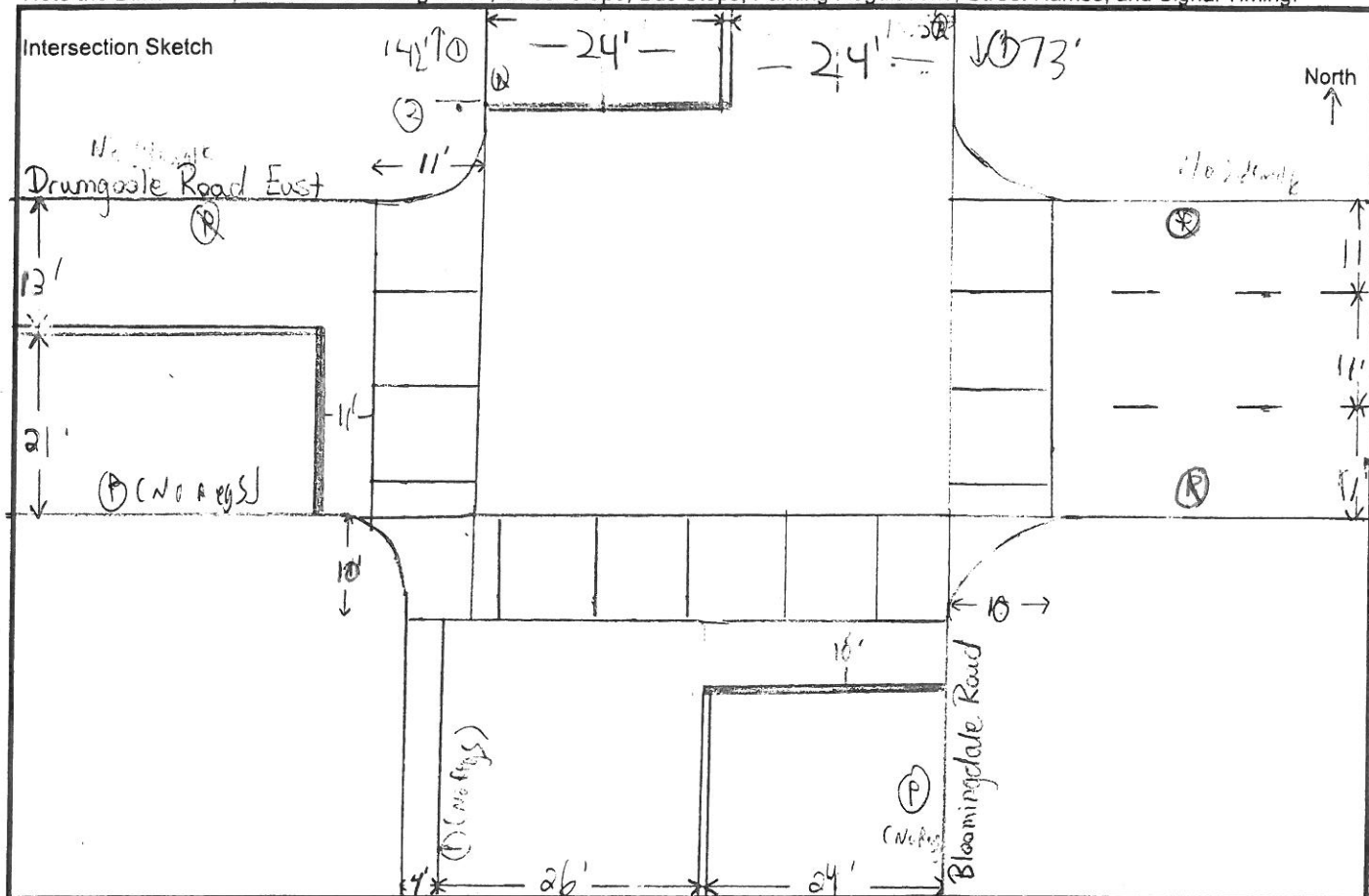
P	A
---	---

Project: Charleston Project #: 11217

Location: Bloomington Road and Drumgale Road East

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

- (1) No BUS M-F 555 X22 ()
- (2) AFTER STOP RIGHT TURN PERMITTED ON RED XEPT 8 A-4P ()
- () ()
- () ()
- () ()
- () ()
- () ()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

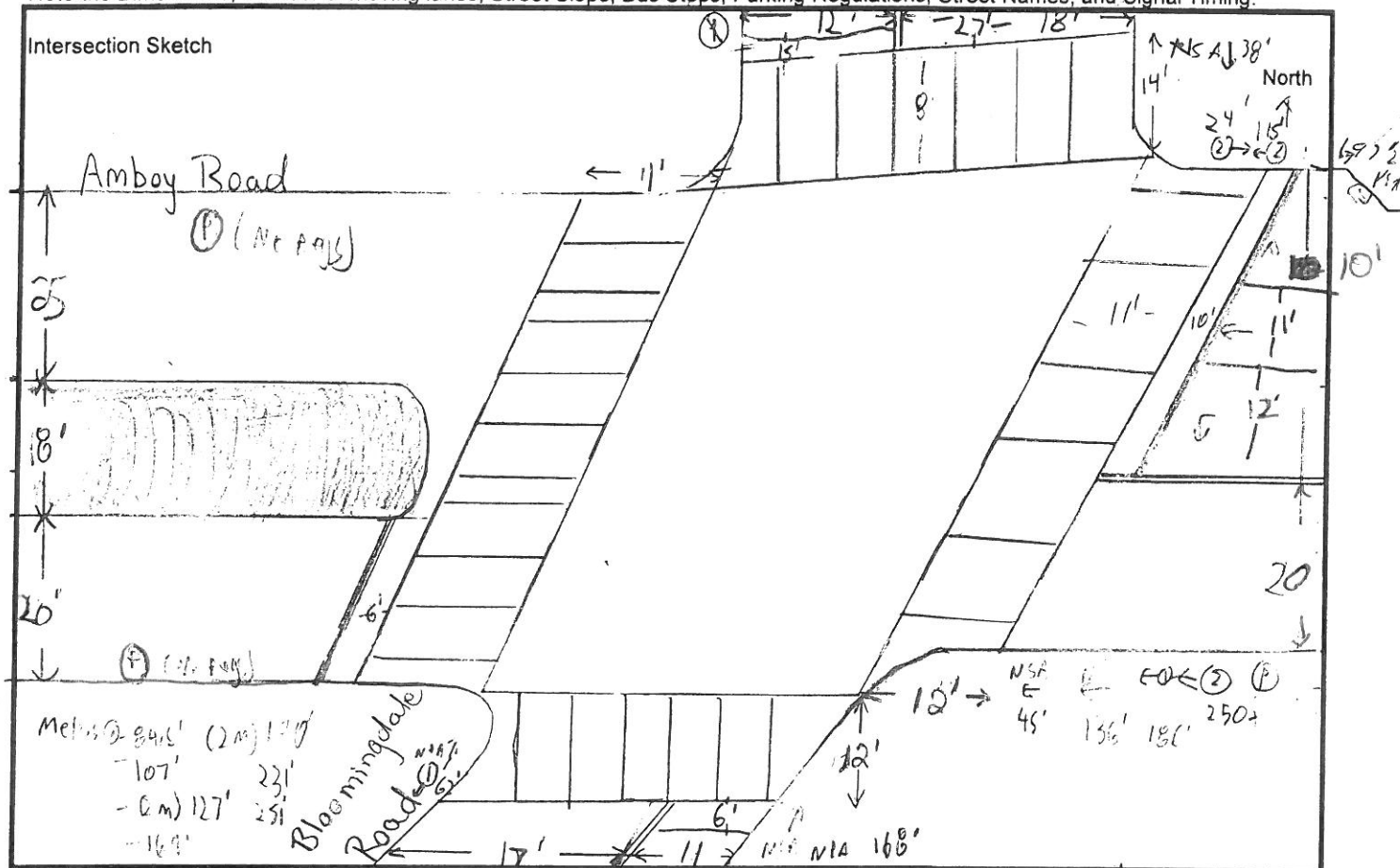
Y	N
---	---

Signal Type

P	A
---	---

Date: Weather: Surveyor:

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.



Parking Regulations

(1) 2NR(P) 8A-7P Ex SUN
(2) NS 6A-7P M-F BU, SS
()
()
()
()
()
()
d NSR (1) / 255

()
()
()
()
()
()

Signal Timing

Approach	Phasing Diagram	Green Time(Sec.) AM/MD/PM/Sat. MD	Y+AR
----------	-----------------	--------------------------------------	------

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

Y	N
---	---

Signal Type

P	A
---	---

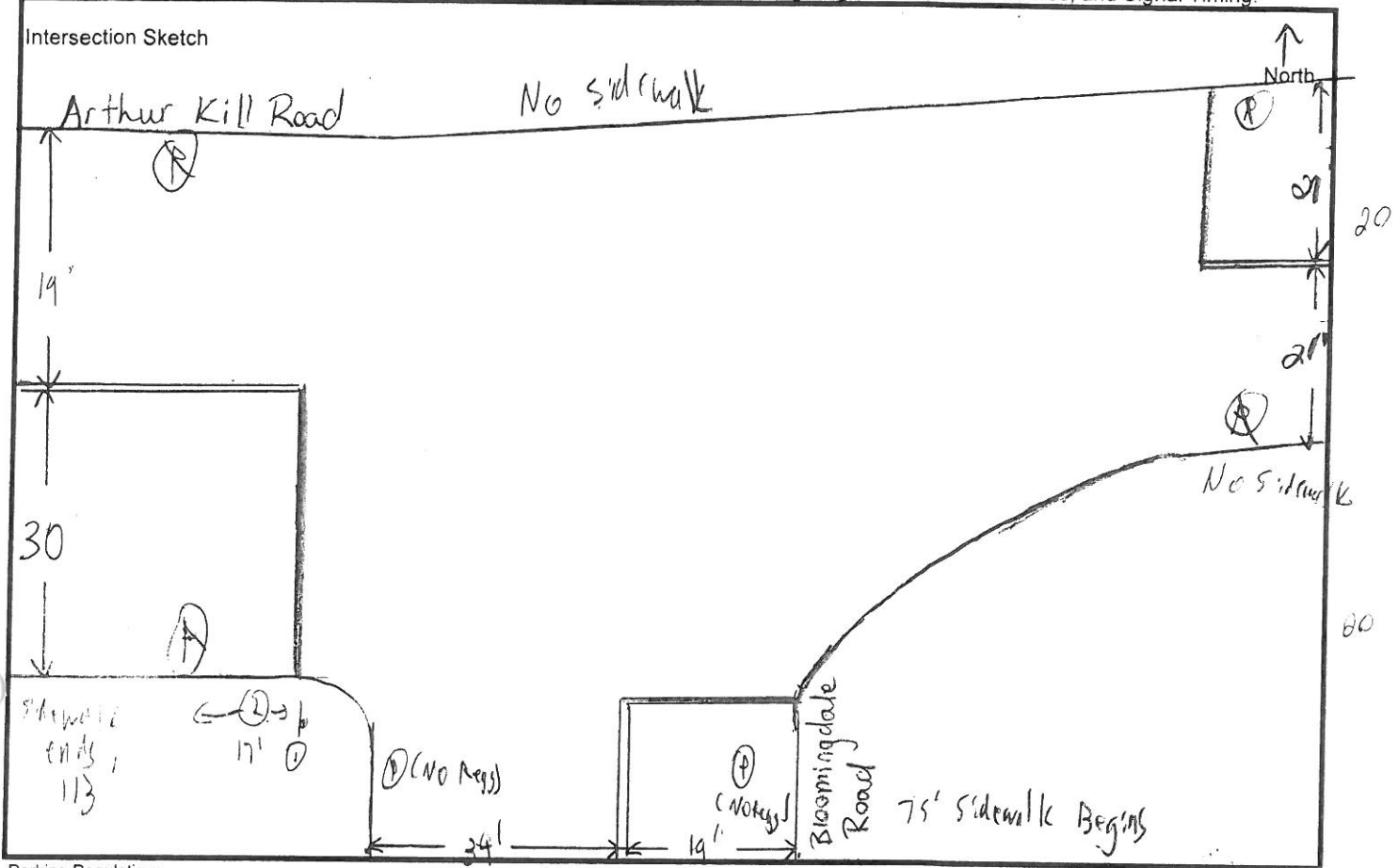
Project: Charleston Project #: 1181A

Location: Bloomingdale Road and Arthur Kill Road

Date: _____ Weather: _____ Surveyor: _____

Note the Dimensions, Number of moving lanes, Street Slope, Bus Stops, Parking Regulations, Street Names, and Signal Timing.

Intersection Sketch



Parking Regulations

- (1) AFTER STOPPED PERMITTED ON RED ()
- (2) NO BUS 555 574 ()
- () ()
- () ()
- () ()
- () ()

Signal Timing

Approach	Phasing Diagram	Green Time (Sec.) AM/MD/PM/Sat. MD	Y+AR

Cycle Length

AM	MD
PM	Sat. MD

Pedestrian Button

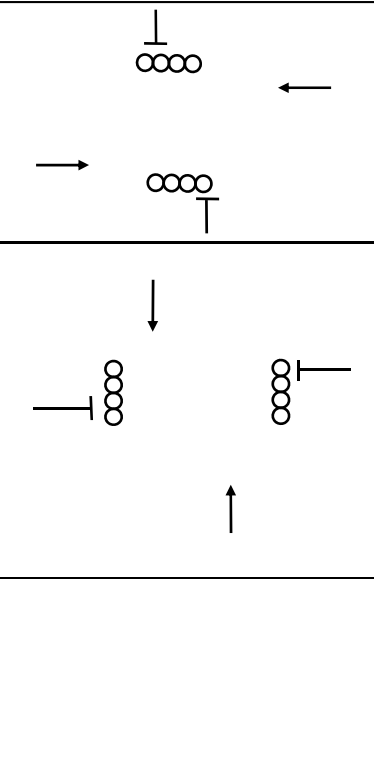
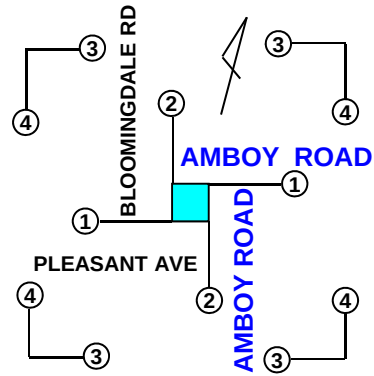
Y	N
---	---

Signal Type

P	A
---	---

Signal Timing

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW	DW								
	A	A	WK	WK								
	G	G										
Phase A	G	R	WK	DW								
SPARE	G	R	WK	DW								
PED CL	G	R	FLDW	DW								
VEH CL	A	R	DW	DW								
VEH CL	R	R	DW	DW								
Phase B	R	G	DW	WK								
SPARE	R	G	DW	WK								
SPARE	R	G	DW	WK								
PED CL	R	G	DW	FLDW								
PED CL	R	G	DW	DW								
VEH CL	R	A	DW	DW								
VEH CL	R	R	DW	DW								



6:00 – 9:45 MON-FRI	9:45 – 15:45 19:30 – 6:00 MON-FRI Weekend -AAT	15:45 – 19:30 MON-FRI	
90 SEC CYCLE	90 SEC CYCLE	90 SEC CYCLE	
28	28	28	
2	2	2	
10	10	10	
3	3	3	
2	2	2	
21	21	21	
2	2	2	
2	2	2	
13	13	13	
2	2	2	
3	3	3	
2	2	2	
OFFSET			
82	0	73	

01/07	YL	INSTALL ADDITIONAL PEDESTRIAN SIGNALS
08/06	YL	REVISE "FLDW"
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC – 6 Type Controller

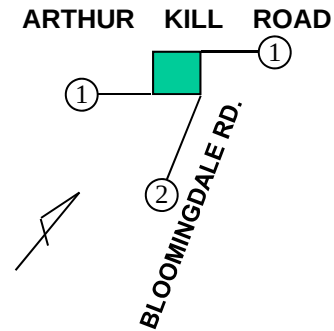
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

AMBOY ROAD @ BLOOMINGDALE ROAD

Prep. Y. Lak Date 02-19-04
Apr. _____ Date _____

Dwg No.
LB 1057a R

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R										
	A	A										
	G	G										
Phase A	G	R										
SPARE	G	R										
SPARE	G	R										
VEH CL	A	R										
VEH CL	R	R										
Phase B	R	G										
SPARE	R	G										
SPARE	R	G										
SPARE	R	G										
SPARE	R	G										
VEH CL	R	A										
VEH CL	R	R										



AT ALL TIMES			
90 SEC CYCLE			
23			
2			
20			
3			
2			
22			
2			
2			
7			
2			
3			
2			
OFFSET			
00			

DATE	BY	REVISIONS

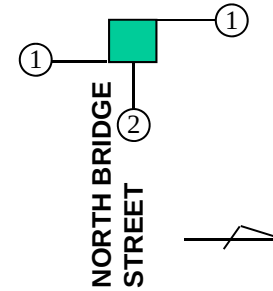
NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
ARTHUR KILL ROAD @ BLOOMINGDALE ROAD	
Prep. <u>Y. Lak</u> Appr. _____	Date <u>08-28-04</u> Date _____
Dwg No. LB 13117 R	

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R										
	A	A										
	G	G										
Phase A	G	R										
SPARE	G	R										
SPARE	G	R										
VEH CL	A	R										
VEH CL	R	R										
Phase B	R	G										
SPARE	R	G										
SPARE	R	G										
SPARE	R	G										
SPARE	R	G										
VEH CL	R	A										
VEH CL	R	R										

ARTHUR KILL ROAD



AT ALL TIMES			
60 SEC CYCLE			
18			
2			
10			
3			
2			
9			
2			
2			
5			
2			
3			
2			
OFFSET			
35			

09/06	YL	CHANGE OFFSET
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

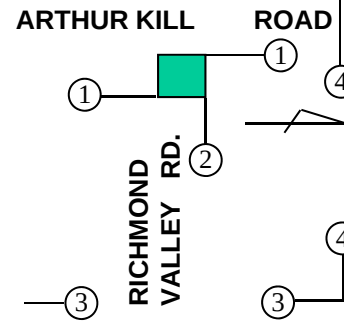
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

ARTHUR KILL ROAD @ NORTH BRIDGE STREET

Prep. Y. Lak Date 02-13-06
Appr. _____ Date _____

Dwg No.
LB 14215 R

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW	DW								
	A	A	WK	WK								
	G	G										
Phase A	G	R	WK	DW								
SPARE	G	R	WK	DW								
PED CL	G	R	FLDW	DW								
VEH CL	A	R	DW	DW								
VEH CL	R	R	DW	DW								
Phase B	R	G	DW	WK								
SPARE	R	G	DW	WK								
SPARE	R	G	DW	WK								
PED CL	R	G	DW	FLDW								
PED CL	R	G	DW	DW								
VEH CL	R	A	DW	DW								
VEH CL	R	R	DW	DW								



AT ALL TIMES			
60 SEC CYCLE			
22			
2			
10			
3			
2			
4			
2			
2			
6			
2			
3			
2			
OFFSET			
00			

05/05	YL	CYCLE LENGTH CHANGED
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

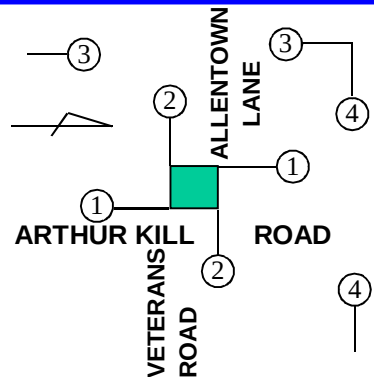
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
 34-02 Queens Blvd, Long Island City, NY 11101

ARTHUR KILL ROAD @ RICHMOND VALLEY ROAD

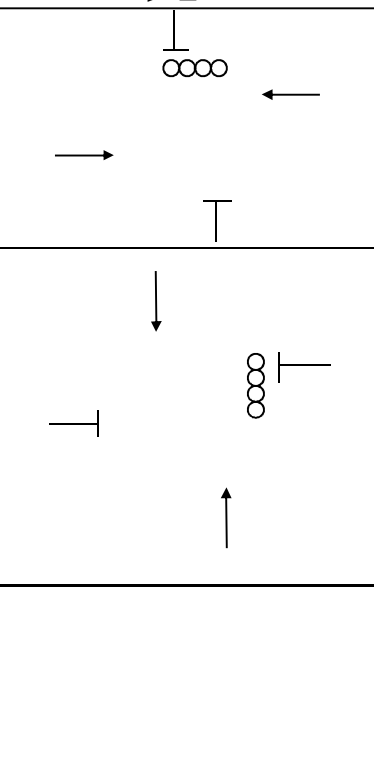
Prep. Y. Lak Date 05-09-05
 Appr. _____ Date _____

Dwg No.
 LB 140832 R

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW	DW								
A	A	WK	WK								
G	G										



Phase A	G	R	WK	DW							
SPARE	G	R	WK	DW							
PED CL	G	R	FLDW	DW							
VEH CL	A	R	DW	DW							
VEH CL	R	R	DW	DW							
Phase B	R	G	DW	WK							
SPARE	R	G	DW	WK							
SPARE	R	G	DW	WK							
PED CL	R	G	DW	FLDW							
PED CL	R	G	DW	DW							
VEH CL	R	A	DW	DW							
VEH CL	R	R	DW	DW							



AT ALL TIMES			
60 SEC CYCLE			
13			
2			
10			
3			
2			
11			
2			
2			
8			
2			
3			
2			
OFFSET			
00			

DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

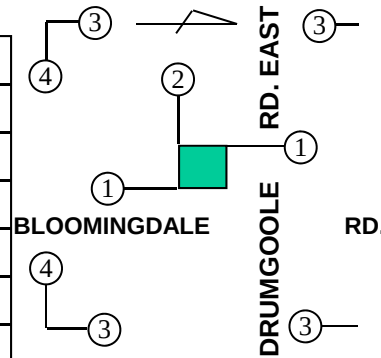
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

**ARTHUR KILL ROAD @
VETERANS ROAD WEST & ALLENTOWN LANE**

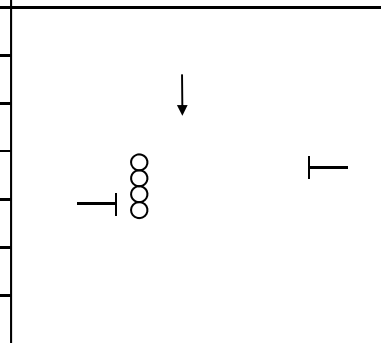
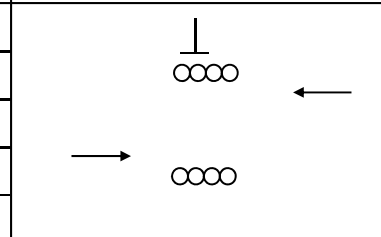
Prep. Y. Lak Date 05-20-05
Appr. _____ Date _____

Dwg No.
LB 14093 R

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW	DW								
A	A	WK	WK								
G	G										



Phase A	G	R	WK	DW							
SPARE	G	R	WK	DW							
PED CL	G	R	FLDW	DW							
VEH CL	A	R	DW	DW							
VEH CL	R	R	DW	DW							
Phase B	R	G	DW	WK							
SPARE	R	G	DW	WK							
SPARE	R	G	DW	WK							
PED CL	R	G	DW	FLDW							
PED CL	R	G	DW	DW							
VEH CL	R	A	DW	DW							
VEH CL	R	R	DW	DW							



AT ALL TIMES			
60 SEC CYCLE			
22			
2			
9			
3			
2			
4			
2			
2			
7			
2			
3			
2			
OFFSET			
00			

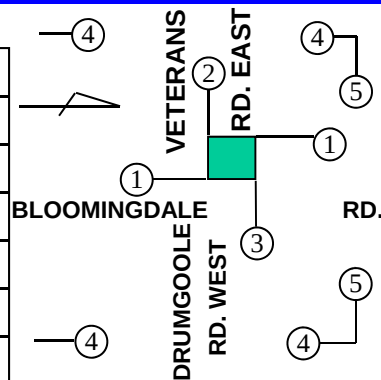
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

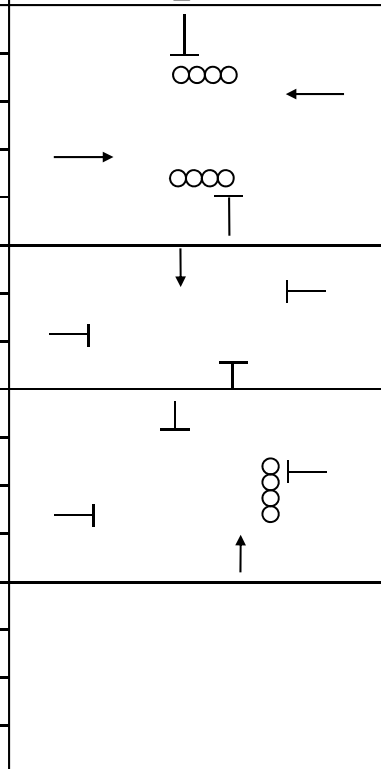
ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
BLOOMINGDALE ROAD @ DRUMGOOLE ROAD EAST	
Prep. <u>Y. Lak</u> Appr. _____	Date <u>01-19-05</u> Date _____
Dwg No. LB 14027 R	

1	2	3	4	5	6	7	8	9	10	11	12
R	R	R	DW	DW							
A	A	A	WK	WK							
G	G	G									



Phase A	G	R	R	WK	DW						
SPARE	G	R	R	WK	DW						
PED CL	G	R	R	FLDW	DW						
VEH CL	A	R	R	DW	DW						
VEH CL	R	R	R	DW	DW						
Phase B	R	G	R	DW	DW						
VEH CL	R	A	R	DW	DW						
VEH CL	R	R	R	DW	DW						
Phase C	R	R	G	DW	WK						
PED CL	R	R	G	DW	FLDW						
VEH CL	R	R	A	DW	DW						
VEH CL	R	R	R	DW	DW						



AT ALL TIMES			
60 SEC CYCLE			
5			
2			
13			
3			
2			
8			
3			
2			
6			
11			
3			
2			
OFFSET			
00			

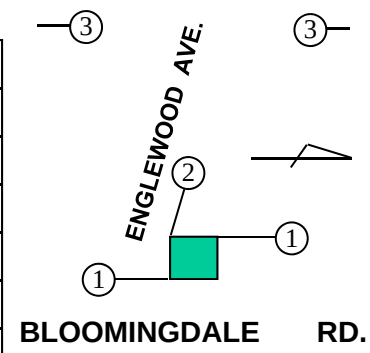
DATE	BY	REVISIONS

NOTES: SEMI - ACTUATED (PHASE B ONLY)

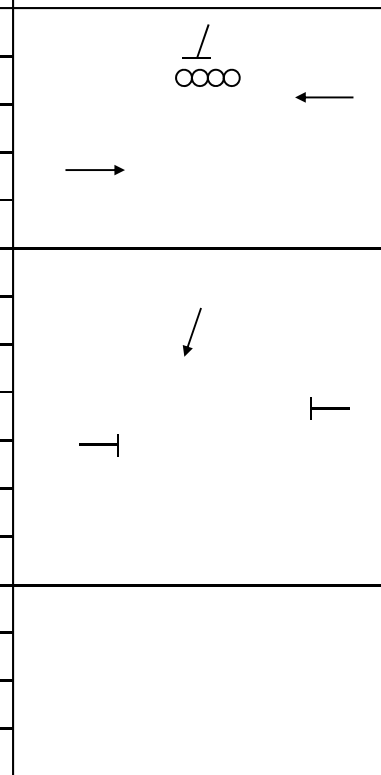
ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101		
BLOOMINGDALE ROAD @ DRUMGOOLE ROAD WEST & VETERANS RD. EAST		
Prep. Y. Lak	Date 01-24-05	Dwg No. LB 12830 R
Appr. _____	Date _____	

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW									
A	A	WK									
G	G										



Phase A	G	R	WK								
SPARE	G	R	WK								
PED CL	G	R	FLDW								
VEH CL	A	R	DW								
VEH CL	R	R	DW								
Phase B	R	G	DW								
SPARE	R	G	DW								
SPARE	R	G	DW								
SPARE	R	G	DW								
SPARE	R	G	DW								
VEH CL	R	A	DW								
VEH CL	R	R	DW								



AT ALL TIMES			
60 SEC CYCLE			
22			
2			
10			
3			
2			
4			
2			
2			
6			
2			
3			
2			
OFFSET			
0			

DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

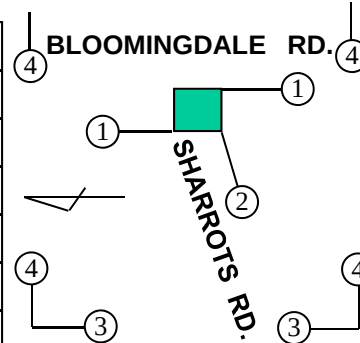
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

BLOOMINGDALE ROAD @ ENGLEWOOD AVENUE

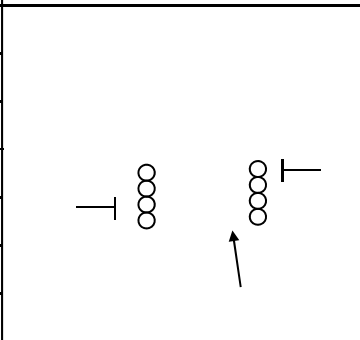
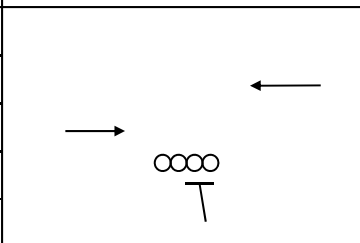
Prep. Y. Lak Date 01-22-05
Appr. _____ Date _____

Dwg No.
LB 14139 R

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW	DW								
A	A	WK	WK								
G	G										



Phase A	G	R	WK	DW							
SPARE	G	R	WK	DW							
PED CL	G	R	FLDW	DW							
VEH CL	A	R	DW	DW							
VEH CL	R	R	DW	DW							
Phase B	R	G	DW	WK							
SPARE	R	G	DW	WK							
SPARE	R	G	DW	WK							
PED CL	R	G	DW	FLDW							
PED CL	R	G	DW	DW							
VEH CL	R	A	DW	DW							
VEH CL	R	R	DW	DW							



AT ALL TIMES			
60 SEC CYCLE			
16			
2			
12			
3			
2			
4			
2			
2			
10			
2			
3			
2			
OFFSET			
0			

DATE	BY	REVISIONS

NOTES: SEMI - ACTUATED
ASTC - 6 Type Controller

CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

BLOOMINGDALE ROAD @ SHARROTT'S ROAD

Prep. Y. Lak Date 09-04-04
Appr. _____ Date _____

Dwg No.
LB 12820 R

BOSCOMBE AVE.

KOREAN WAR VET.
PKWY E/B EXIT

KOREAN WAR VET.
PKWY E/B ENT.

GATEWAY CATHEDRAL

ALL OTHER TIMES	16:00 – 19:30 MON - FRI	15:00 – 19:30 SATURDAY	
90 SEC CYCLE	90 SEC CYCLE	90 SEC CYCLE	
10	16	16	
2	2	2	
10	10	10	
3	3	3	
2	2	2	
14	12	12	
2	2	2	
3	3	3	
2	2	2	
37	33	33	
3	3	3	
2	2	2	
OFFSET			
58	58	58	

NOTES: NON - ACTUATED

ASTC – 6 Type Controller

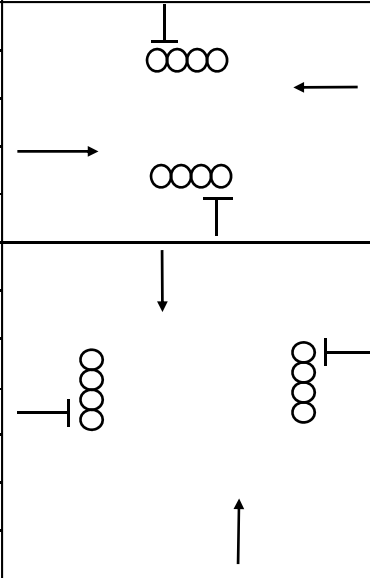
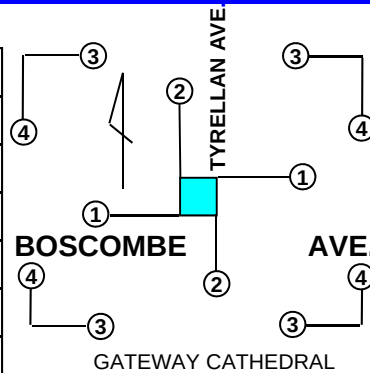
PC = 3.0 ft/sec

CABINET ADDRESS: 7421

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
BOSCOMBE AVENUE @ KOREAN WAR VETERANS PKWY E/B ENT/EXIT	
Prep. <u>Y. Lak</u> Date <u>09-21-10</u> Appr. _____ Date _____	Dwg No. LB 13223 R

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW	DW								
A	A	WK	WK								
G	G										

Phase A	G	R	WK	DW							
SPARE	G	R	WK	DW							
PED CL	G	R	FLDW	DW							
VEH CL	A	R	DW	DW							
VEH CL	R	R	DW	DW							
Phase B	R	G	DW	WK							
SPARE	R	G	DW	WK							
SPARE	R	G	DW	WK							
PED CL	R	G	DW	FLDW							
PED CL	R	G	DW	DW							
VEH CL	R	A	DW	DW							
VEH CL	R	R	DW	DW							



AAT			
90 SEC CYCLE			
31			
2			
12			
3			
2			
17			
2			
2			
12			
2			
3			
2			
OFFSET			
0			

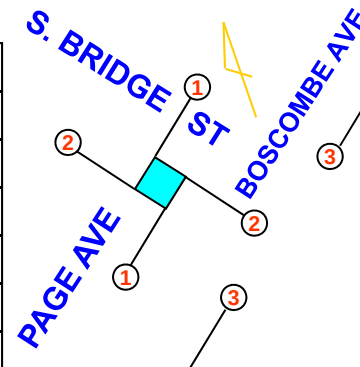
12/05	YL	CHANGED CYCLE LENGTH FROM 60 SEC TO 90 SEC
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

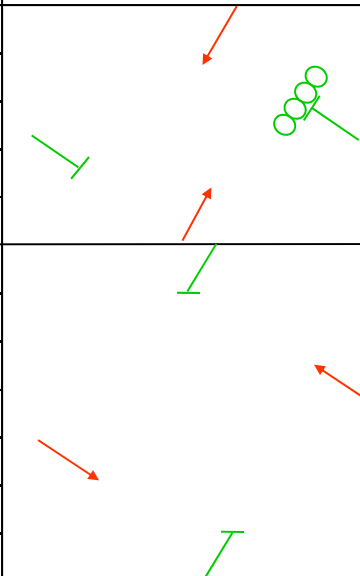
ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
BOSCOMBE AVENUE @ TYRELLAN AVENUE	
Prep. <u>Y. Lak</u> Appr. _____	Date <u>09-23-05</u> Date _____
Dwg No. LB 14140R	

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW									
A	A	WK									
G	G										



Phase A	G	R	WK								
SPARE	G	R	WK								
PED CL	G	R	FLDW								
VEH CL	A	R	DW								
VEH CL	R	R	DW								
Phase B	R	G	DW								
SPARE	R	G	DW								
SPARE	R	G	DW								
PED CL	R	G	DW								
PED CL	R	G	DW								
VEH CL	R	A	DW								
VEH CL	R	R	DW								



AAT			
90 SEC CYCLE			
38			
2			
10			
3			
2			
17			
2			
2			
7			
2			
3			
2			
OFFSET			
0			

12/05	YL	CHANGED CYCLE LENGTH FROM 60 SEC TO 90 SEC
DATE	BY	REVISIONS

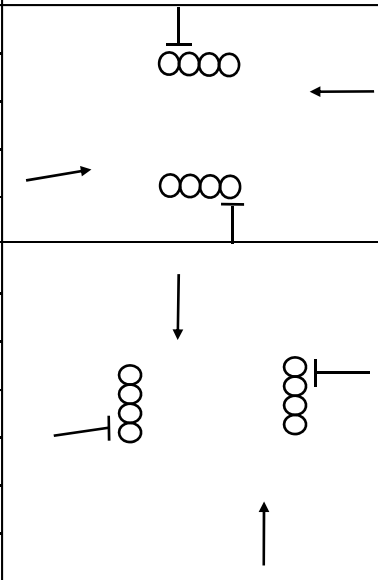
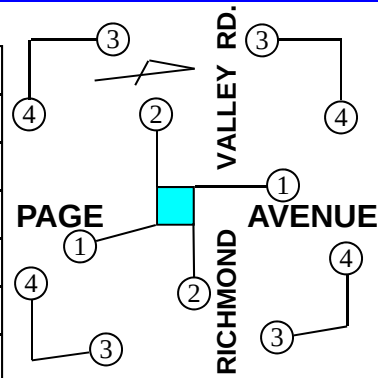
NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101		
PAGE AVENUE @ BOSCOMBE AVE & SOUTH BRIDGE STREET		
Prep. <u>N.Ibrahim</u> Appr. _____	Date <u>10-09-04</u> Date _____	Dwg No. LB

1	2	3	4	5	6	7	8	9	10	11	12
R	R	DW	DW								
A	A	WK	WK								
G	G										

Phase A	G	R	WK	DW							
SPARE	G	R	WK	DW							
PED CL	G	R	FLDW	DW							
VEH CL	A	R	DW	DW							
VEH CL	R	R	DW	DW							
Phase B	R	G	DW	WK							
SPARE	R	G	DW	WK							
SPARE	R	G	DW	WK							
PED CL	R	G	DW	FLDW							
PED CL	R	G	DW	DW							
VEH CL	R	A	DW	DW							
VEH CL	R	R	DW	DW							



AAT			
90 SEC CYCLE			
35			
2			
12			
3			
2			
10			
2			
2			
15			
2			
3			
2			
OFFSET			
0			

04/07	YL	MODIFY PHASING
04/07	YL	CHANGE TO FIXED TIME OPERATION
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

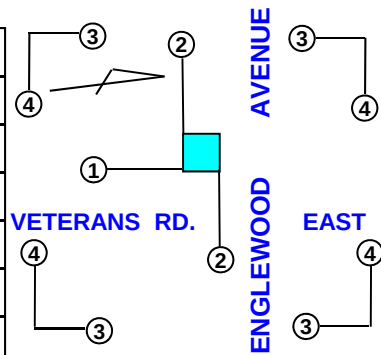
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
 34-02 Queens Blvd, Long Island City, NY 11101

PAGE AVENUE @ RICHMOND VALLEY ROAD

Prep. Y. Lak Date 04-12-07
 Appr. _____ Date _____

Dwg No.
 LB 12008R

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW	DW								
	A	A	WK	WK								
	G	G										
Phase A	G	R	WK	DW								
SPARE	G	R	WK	DW								
PED CL	G	R	FLDW	DW								
VEH CL	A	R	DW	DW								
VEH CL	R	R	DW	DW								
Phase B	R	G	DW	WK								
SPARE	R	G	DW	WK								
SPARE	R	G	DW	WK								
PED CL	R	G	DW	FLDW								
PED CL	R	G	DW	DW								
VEH CL	R	A	DW	DW								
VEH CL	R	R	DW	DW								



AAT			
60 SEC CYCLE			
15			
2			
12			
3			
2			
3			
2			
2			
12			
2			
3			
2			
OFFSET			
0			

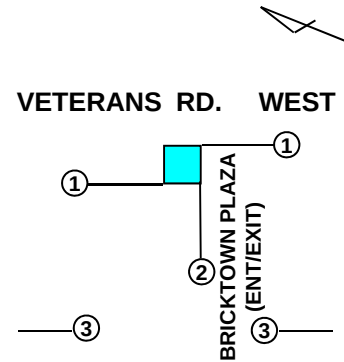
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
VETERANS ROAD EAST @ ENGLEWOOD AVENUE	
Prep. <u>Y. Lak</u> Appr. _____	Date <u>11-02-06</u> Date _____
Dwg No. LB 14141R	

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW									
	A	A	WK									
	G	G										
Phase A	G	R	WK									
SPARE	G	R	WK									
PED CL	G	R	FLDW									
VEH CL	A	R	DW									
VEH CL	R	R	DW									
Phase B	R	G	DW									
SPARE	R	G	DW									
SPARE	R	G	DW									
SPARE	R	G	DW									
SPARE	R	G	DW									
VEH CL	R	A	DW									
VEH CL	R	R	DW									



AAT			
60 SEC CYCLE			
5			
2			
24			
3			
2			
11			
2			
2			
2			
2			
3			
2			
OFFSET			
0			

DATE	BY	REVISIONS

NOTES: NON - ACTUATED

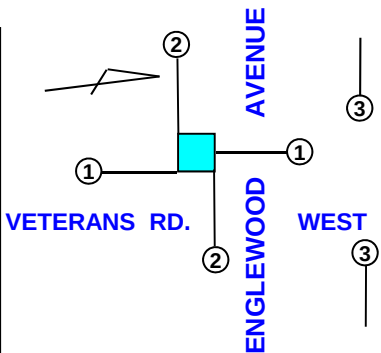
ASTC - 6 Type Controller

(PC: 3.0 Ft/Sec)

CABINET ADDRESS 744E

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
VETERANS ROAD WEST @ BRICKTOWN PLAZA (ENT/EXIT) (1600' EAST OF TYRELLAN AVENUE)	
Prep. <u>T. Manina</u> Apr. _____	Date <u>05-19-10</u> Date _____
Dwg No. _____ LB _____ R _____	

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW									
	A	A	WK									
	G	G										
Phase A	G	R	DW									
SPARE	G	R	DW									
PED CL	G	R	DW									
VEH CL	A	R	DW									
VEH CL	R	R	DW									
Phase B	R	G	WK									
SPARE	R	G	WK									
SPARE	R	G	WK									
PED CL	R	G	FLDW									
PED CL	R	G	DW									
VEH CL	R	A	DW									
VEH CL	R	R	DW									



AAT			
60 SEC CYCLE			
11			
2			
12			
3			
2			
7			
2			
2			
12			
2			
3			
2			
OFFSET			
0			

DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC – 6 Type Controller

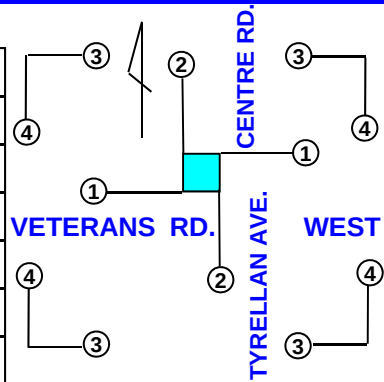
CITY OF NEW YORK
BUREAU OF TRAFFIC OPERATIONS
34-02 Queens Blvd, Long Island City, NY 11101

VETERANS ROAD WEST @ ENGLEWOOD AVENUE

Prep. Y. Lak Date 09-16-05
Apr. _____ Date _____

Dwg No.
LB 14138R

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	DW	DW								
	A	A	WK	WK								
	G	G										
Phase A	G	R	WK	DW								
SPARE	G	R	WK	DW								
PED CL	G	R	FLDW	DW								
VEH CL	A	R	DW	DW								
VEH CL	R	R	DW	DW								
Phase B	R	G	DW	WK								
SPARE	R	G	DW	WK								
SPARE	R	G	DW	WK								
PED CL	R	G	DW	FLDW								
PED CL	R	G	DW	DW								
VEH CL	R	A	DW	DW								
VEH CL	R	R	DW	DW								



AAT			
90 SEC CYCLE			
26			
2			
12			
3			
2			
22			
2			
2			
12			
2			
3			
2			
OFFSET			
0			

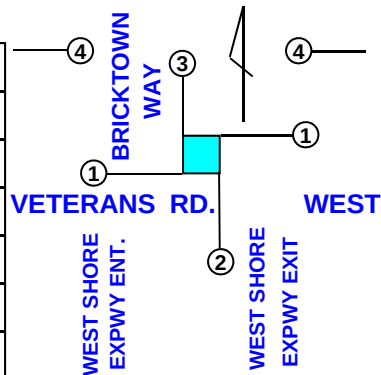
01/06	YL	CHANGED CYCLE LENGTH FROM 60 SEC TO 90 SEC.
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC - 6 Type Controller

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
VETERANS ROAD WEST @ TYRELLAN AVENUE & CENTRE ROAD	
Prep. <u>Y. Lak</u> Apr. _____	Date <u>09-19-05</u> Date _____
Dwg No. LB 14137R	

	1	2	3	4	5	6	7	8	9	10	11	12
	R	R	R	DW								
	A	A	A	WK								
	G	G	G									
Phase A	G	R	R	WK								
SPARE	G	R	R	WK								
PED CL	G	R	R	FLDW								
VEH CL	A	R	R	DW								
VEH CL	R	R	R	DW								
Phase B	R	G	R	DW								
SPARE	R	G	R	DW								
VEH CL	R	A	R	DW								
VEH CL	R	R	R	DW								
Phase C	R	R	G	DW								
VEH CL	R	R	A	DW								
VEH CL	R	R	R	DW								



AOT			
90 SEC CYCLE			
14			
2			
14			
3			
2			
23			
2			
3			
2			
20			
3			
2			
OFFSET			
0			

01/09	YL	CHANGE TIMING
DATE	BY	REVISIONS

NOTES: **NON - ACTUATED**

ASTC – 6 Type Controller

CABINET ADDRESS 742D

CITY OF NEW YORK BUREAU OF TRAFFIC OPERATIONS 34-02 Queens Blvd, Long Island City, NY 11101	
VETERANS ROAD WEST @ WEST SHORE EXPWY ENT/EXIT & BRICKTOWN WAY	
Prep. <u>Y. Lak</u> Appr. _____	Date <u>10-06-05</u> Date _____
Dwg No. LB 14136R	

Existing 2011

Weekday

AM

TWO-WAY STOP CONTROL SUMMARY

Analyst:

Agency/Co.: Philip Habib & Associates

Date Performed: 8/03/2011

Analysis Time Period: Weekday 8-9 AM Peak Period

Intersection: Sharrotts Rd & Arthur Kill Rd

Jurisdiction: Staten Island, NY

Units: U. S. Customary

Analysis Year: 2011 Existing Conditions

Project ID: 1121A - Charleston

East/West Street: Sharrotts Road

North/South Street: Arthur Kill Road

Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	 	4 L	5 T	6 R
Volume		25	129	38		27	124	36
Peak-Hour Factor, PHF		0.83	0.83	0.83		0.83	0.83	0.83
Hourly Flow Rate, HFR		30	155	45		32	149	43
Percent Heavy Vehicles		20	--	--		13	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	 	10 L	11 T	12 R
Volume		56	9	26		8	7	7
Peak Hour Factor, PHF		0.95	0.95	0.95		0.79	0.79	0.79
Hourly Flow Rate, HFR		58	9	27		10	8	8
Percent Heavy Vehicles		5	5	5		32	32	32
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage		No			/	No		
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	30	32		94			26	
C(m) (vph)	1281	1309		528			481	
v/c	0.02	0.02		0.18			0.05	
95% queue length	0.07	0.08		0.64			0.17	
Control Delay	7.9	7.8		13.3			12.9	
LOS	A	A		B			B	
Approach Delay				13.3			12.9	
Approach LOS				B			B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst:

Agency/Co.: Philip Habib & Associates

Date Performed: 8/03/2011

Analysis Time Period: Weekday 8-9 AM Peak Period

Intersection: Sharrotts Rd & Arthur Kill Rd

Jurisdiction: Staten Island, NY

Units: U. S. Customary

Analysis Year: 2011 Existing Conditions

Project ID: 1121A - Charleston

East/West Street: Sharrotts Road

North/South Street: Arthur Kill Road

Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	25	129	38	27	124	36
Peak-Hour Factor, PHF	0.83	0.83	0.83	0.83	0.83	0.83
Peak-15 Minute Volume	8	39	11	8	37	11
Hourly Flow Rate, HFR	30	155	45	32	149	43
Percent Heavy Vehicles	20	--	--	13	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street Movements	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume	56	9	26	8	7	7		
Peak Hour Factor, PHF	0.95	0.95	0.95	0.79	0.79	0.79		
Peak-15 Minute Volume	15	2	7	3	2	2		
Hourly Flow Rate, HFR	58	9	27	10	8	8		
Percent Heavy Vehicles	5	5	5	32	32	32		
Percent Grade (%)		0			0			
Flared Approach: Exists?/Storage			No	/			No	/
RT Channelized?								
Lanes	0	1	0	0	1	0		
Configuration		LTR			LTR			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	155	149
Shared ln volume, major rt vehicles:	45	43
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	20	13	5	5	5	32	32	32
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.3	4.2	7.2	6.6	6.3	7.4	6.8	6.5
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	20	13	5	5	5	32	32	32
t(f)	2.4	2.3	3.5	4.0	3.3	3.8	4.3	3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	192	200	480	494	178	490	494	170
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x) s P(x) V(c,u,x)		1500		1500		1500		1500
C(r,x) C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	178	170
Potential Capacity	857	802
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	857	802
Probability of Queue free St.	0.97	0.99
Step 2: LT from Major St.	4	1
Conflicting Flows	200	192
Potential Capacity	1309	1281
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1309	1281
Probability of Queue free St.	0.98	0.98
Maj L-Shared Prob Q free St.	0.97	0.97
Step 3: TH from Minor St.	8	11
Conflicting Flows	494	494
Potential Capacity	472	436
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	447	413
Probability of Queue free St.	0.98	0.98
Step 4: LT from Minor St.	7	10
Conflicting Flows	480	490
Potential Capacity	491	443
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.94
Cap. Adj. factor due to Impeding mvmnt	0.94	0.91
Movement Capacity	459	405

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	494	494
Potential Capacity	472	436
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity	447	413

Result for 2 stage process:

a		
y		
C t	447	413
Probability of Queue free St.	0.98	0.98

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	480	490
Potential Capacity	491	443
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.93	0.93
Maj. L, Min T Adj. Imp Factor.	0.95	0.94
Cap. Adj. factor due to Impeding mvmnt	0.94	0.91
Movement Capacity	459	405

Results for Two-stage process:

a		
y		
C t	459	405

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	58	9	27	10	8	8
Movement Capacity (vph)	459	447	857	405	413	802
Shared Lane Capacity (vph)		528			481	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	459	447	857	405	413	802
Volume	58	9	27	10	8	8
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		528			481	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	30	32		94			26	
C(m) (vph)	1281	1309		528			481	
v/c	0.02	0.02		0.18			0.05	
95% queue length	0.07	0.08		0.64			0.17	
Control Delay	7.9	7.8		13.3			12.9	
LOS	A	A		B			B	
Approach Delay				13.3			12.9	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.98
v(i1), Volume for stream 2 or 5	155	149
v(i2), Volume for stream 3 or 6	45	43
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.97	0.97
d(M,LT), Delay for stream 1 or 4	7.9	7.8
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.2	0.2

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	 	4 L	5 T	6 R
Volume			177	30		19	168	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			213	36		22	202	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided				/		
RT Channelized?								
Lanes			1	0			0	1
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	 	10 L	11 T	12 R
Volume		7		15				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		10		21				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		22			31					
C(m) (vph)		1266			700					
v/c		0.02			0.04					
95% queue length		0.05			0.14					
Control Delay		7.9			10.4					
LOS		A			B					
Approach Delay					10.4					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		177	30	19	168	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		53	9	6	51	
Hourly Flow Rate, HFR		213	36	22	202	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	7		15			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	3		5			
Hourly Flow Rate, HFR	10		21			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		202
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		249	477		231			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	231	
Potential Capacity	813	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	813	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	249	
Potential Capacity	1266	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1266	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	477	
Potential Capacity	551	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	541	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 477
Potential Capacity 551
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 541

Results for Two-stage process:

a
y
C t 541

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		21			
Movement Capacity (vph)	541		813			
Shared Lane Capacity (vph)		700				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	541		813			
Volume	10		21			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		700				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		22		31				
C(m) (vph)		1266		700				
v/c		0.02		0.04				
95% queue length		0.05		0.14				
Control Delay		7.9		10.4				
LOS		A		B				
Approach Delay				10.4				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		202
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		7.9
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/28/2011 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	136	32	244	0	132	256	63	104	8
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 721 1730 0.02 0.42 10.3 B 10.3 B

Westbound

LT 545 1307 0.35 0.42 13.7 B 15.7 B
 R 514 1233 0.54 0.42 17.1 B

Northbound

LTR 703 1688 0.65 0.42 18.1 B 18.1 B

Southbound

LTR 519 1246 0.39 0.42 14.3 B 14.3 B

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	136	32	244	0	132	256	63	104	8
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	39	9	70	0	39	75	18	30	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			193	280		456			201	
%InSharedLn												
Prop LTs		0.273			0.808			0.000			0.358	
Prop RTs		0.091			0.000	1.000		0.660			0.045	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	136	32	244	0	132	256	63	104	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	156	37	280	0	155	301	72	120	9
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			193 280			456			201		
Prop LTs	0.273			0.808			0.000			0.358		
Prop RTs	0.091			0.000 1.000			0.660			0.045		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.911			0.994		
fLT	0.953			0.762			1.000			0.654		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1730			1307 1233			1688			1246		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1730	0.01	0.42	721	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	193	1307	0.15	0.42	545	0.35
Right	R	280	1233	# 0.23	0.42	514	0.54
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	456	1688	# 0.27	0.42	703	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	201	1246	0.16	0.42	519	0.39
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	721	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.35	0.42	12.0	1.000	545	0.50	1.7	0.0	13.7	B	15.7	B
R	0.54	0.42	13.2	1.000	514	0.50	3.9	0.0	17.1	B		
Northbound												
LTR	0.65	0.42	14.0	1.000	703	0.50	4.1	0.0	18.1	B	18.1	B
Southbound												
LTR	0.39	0.42	12.2	1.000	519	0.50	2.2	0.0	14.3	B	14.3	B

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	156	0	72
Proportion of LT in LT lane group, PLT	0.273	0.808	0.000	0.358
Proportion of LT in opposing flow, PLTo	0.81	0.27	0.36	0.00
Adjusted opposing flow rate, Vo (veh/h)	193	11	201	456
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	2.60	0.00	1.20
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.22	0.18	3.35	7.60
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.2	0.0	4.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	1.80	0.00	2.01	8.09
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	24.79	22.99	16.91
n=Max(gq-gf)/2,0)	0.00	0.00	1.00	1.78
PTHo=1-PLTo	0.19	0.73	0.64	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.81	0.00	0.36
EL1 (refer to Exhibit C16-3)	1.69	1.39	1.70	2.20
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.14	0.08	0.11
gdif=max(gq-gf,0)	0.00	0.00	2.01	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95	0.76	1.00	0.65
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.953	0.762	1.000	0.654

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	1.80			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.072			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	193			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	25.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	17.5	10.3	0.00	0.0	0.0 0.0 0.0	10.3
Westbound								
LT	0.0	0.00	17.5	12.0	0.00	0.0	0.0	13.7
R	0.0	0.00	17.5	13.2	0.00	0.0	0.0	17.1
Northbound								
LTR	0.0 0.0 0.0	0.00	17.5	14.0	0.00	0.0	0.0 0.0 0.0	18.1
Southbound								
LTR	0.0 0.0 0.0	0.00	17.5	12.2	0.00	0.0	0.0 0.0 0.0	14.3
Intersection Delay			16.4	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	11			193	280	456		201	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1730			1307	1233	1688		1246	
LnCapacity	721			545	514	703		519	
Flow Ratio	0.0			0.1	0.2	0.3		0.2	
v/c Ratio	0.02			0.35	0.54	0.65		0.39	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.940		0.887		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.1			2.2	3.5	6.1		2.3	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			0.3	0.6	1.1		0.3	
Q Average	0.1			2.5	4.1	7.1		2.7	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.3	1.2	1.2		1.3	
BOQ	0.2			3.1	5.1	8.7		3.4	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.6	1.5	1.5		1.6	
BOQ	0.2			3.9	6.3	10.5		4.2	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.8	1.7	1.6		1.8	
BOQ	0.2			4.5	7.1	11.6		4.8	
QSRatio									
95th Percentile Output:									
fB%	2.6			2.2	2.0	1.8		2.2	
BOQ	0.3			5.5	8.4	13.1		5.8	
QSRatio									
98th Percentile Output:									
fB%	3.2			2.6	2.4	2.1		2.6	
BOQ	0.4			6.5	9.7	14.7		6.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				246		5		383			241	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 632 1895 0.45 0.33 17.8 B 17.8 B

Northbound

T 970 1940 0.46 0.50 11.2 B 11.2 B

Southbound

T 925 1850 0.30 0.50 9.4 A 9.4 A

Intersection Delay = 12.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				246		5	383			241		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				70		2	113			69		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					286		451			277		
%InSharedLn												
Prop LTs					0.979		0.000			0.000		
Prop RTs					0.021		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				246		5	383			241		
PHF				0.88		0.88	0.85			0.87		
Adj flow				280		6	451			277		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					286			451			277	
Prop LTs					0.979			0.000			0.000	
Prop RTs					0.021			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.997			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1895			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	286	1895	# 0.15	0.33	632	0.45
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	451	1940	# 0.23	0.50	970	0.46
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	277	1850	0.15	0.50	925	0.30
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.45	0.33	15.7	1.000	632	0.50	2.1	0.0	17.8	B	17.8	B
Northbound												
T	0.46	0.50	9.8	1.000	970	0.50	1.4	0.0	11.2	B	11.2	B
Southbound												
T	0.30	0.50	8.8	1.000	925	0.50	0.6	0.0	9.4	A	9.4	A

Intersection delay = 12.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.979 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	15.7	0.00	0.0	0.0	17.8
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	8.8	0.00	0.0	0.0	9.4
	0.0						0.0	
Intersection Delay			12.6	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		383	205	111	376	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		113	60	32	108	
Hourly Flow Rate, HFR		450	241	127	432	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		432
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		691						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	691	
Potential Capacity	825	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	825	
Probability of Queue free St.	0.85	1.00
Maj L-Shared Prob Q free St.	0.79	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.85	0.85
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.79 0.79
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.85 0.85
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		127						
C(m) (vph)		825						
v/c		0.15						
95% queue length		0.54						
Control Delay		10.2						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.85
v(i1), Volume for stream 2 or 5		432
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.79
d(M,LT), Delay for stream 1 or 4		10.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.1

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 7/28/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				54		125	463	65		77	299	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 384 1440 0.50 0.27 23.1 C 23.1 C

Northbound

TR 1032 1822 0.60 0.57 10.6 B 10.6 B

Southbound

LT 839 1481 0.52 0.57 9.9 A 9.9 A

Intersection Delay = 12.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				54		125	463	65		77	299	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				15		34	136	19		22	86	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					192			621			433	
%InSharedLn												
Prop LTs					0.302			0.000			0.206	
Prop RTs					0.698			0.122			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				54		125	463	65		77	299	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				58		134	545	76		89	344	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					192			621			433	
Prop LTs					0.302			0.000			0.206	
Prop RTs					0.698			0.122			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.901			0.917	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.906			0.983			1.000	
fLT					0.985			1.000			0.782	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1440			1822			1481	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	192	1440	# 0.13	0.27	384	0.50
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	621	1822	# 0.34	0.57	1032	0.60
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	433	1481	0.29	0.57	839	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.47
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.50	0.27	18.6	1.000	384	0.50	4.5	0.0	23.1	C	23.1	C
Northbound												
TR	0.60	0.57	8.5	1.000	1032	0.50	2.0	0.0	10.6	B	10.6	B
Southbound												
LT	0.52	0.57	8.0	1.000	839	0.50	1.9	0.0	9.9	A	9.9	A

Intersection delay = 12.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			89
Proportion of LT in LT lane group, PLT	0.302	0.000	0.206
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			621
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.08
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.92
n=Max(gq-gf)/2,0)			0.39
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.21
EL1 (refer to Exhibit C16-3)			2.59
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.782

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.08
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.208
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				621
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.206
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCcr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.698	0.122
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.6	0.00	0.0	0.0	23.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.5	0.00	0.0	0.0	10.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	8.0	0.00	0.0	0.0	9.9
	0.0						0.0	
Intersection Delay			12.3	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	60	21	61	20	107	15	48	610	104	49	333	24
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	569	1653	0.28	0.34	22.4	C	22.4	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	585	1699	0.26	0.34	22.3	C	22.3	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	436	801	0.12	0.54	10.3	B		
TR	1048	1925	0.74	0.54	18.7	B	18.2	B

Southbound

LTR	1108	2036	0.43	0.54	13.4	B	13.4	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 17.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60	21	61	20	107	15	48	610	104	49	333	24
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	17	6	17	5	28	4	13	166	28	15	99	7
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		158			151		52	776			475	
%InSharedLn												
Prop LTs		0.424			0.139		1.000	0.000			0.122	
Prop RTs		0.430			0.106			0.146			0.044	
Peds Bikes	0	0		0	0		0	0	0	0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60	21	61	20	107	15	48	610	104	49	333	24
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	67	23	68	21	114	16	52	663	113	58	396	21
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	158			151			52 776			475		
Prop LTs	0.424			0.139			1.000 0.000			0.122		
Prop RTs	0.430			0.106			0.146			0.044		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.942			0.986			0.978			0.993		
fLT	0.823			0.952			0.465 1.000			0.693		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1653			1699			801 1925			2036		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	158	1653	# 0.10	0.34	569	0.28
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	151	1699	0.09	0.34	585	0.26
Right							
Northbound							
Prot							
Perm							
Left	L	52	801	0.06	0.54	436	0.12
Prot							
Perm							
Thru	TR	776	1925	# 0.40	0.54	1048	0.74
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	475	2036	0.23	0.54	1108	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.28	0.34	21.4	1.000	569	0.50	1.0	0.0	22.4	C	22.4	C
Westbound												
LTR	0.26	0.34	21.2	1.000	585	0.50	1.1	0.0	22.3	C	22.3	C
Northbound												
L	0.12	0.54	10.0	1.000	436	0.50	0.4	0.0	10.3	B		
TR	0.74	0.54	15.6	1.000	1048	0.50	3.1	0.0	18.7	B	18.2	B
Southbound												
LTR	0.43	0.54	12.2	1.000	1108	0.50	1.2	0.0	13.4	B	13.4	B

Intersection delay = 17.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			52	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.12	
Adjusted opposing flow rate, Vo (veh/h)			475	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.30	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.24	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			1.60	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			47.40	
n=Max(gq-gf)/2,0)			0.80	
PTHo=1-PLTo			0.88	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.08	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			1.60	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.46	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.465	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	67	21	58
Proportion of LT in LT lane group, PLT	0.424	0.139	0.000
Proportion of LT in opposing flow, PLTo	0.14	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	151	158	776
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.68	0.53	1.45
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.78	3.95	19.40
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	4.4	12.5	10.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	3.69	4.00	26.07
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.57	18.53	22.93
n=Max(gq-gf)/2,0)	0.00	0.00	7.79
PTHo=1-PLTo	0.86	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.14	0.39
EL1 (refer to Exhibit C16-3)	1.61	1.63	3.01
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.95	0.48
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.823	0.952	0.693

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	3.69	4.00	1.60	26.07
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.119	0.129	0.033	0.532
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	151	158	475	776
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.424	0.139	1.000	0.122
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.430	0.106	0.146	0.044
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	21.4	0.00	0.0	0.0 0.0 0.0	22.4
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	21.2	0.00	0.0	0.0 0.0 0.0	22.3
Northbound								
L	0.0	0.00	20.5	10.0	0.00	0.0	0.0	10.3
TR	0.0 0.0	0.00	20.5	15.6	0.00	0.0	0.0 0.0	18.7
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	12.2	0.00	0.0	0.0 0.0 0.0	13.4
Intersection Delay			17.6	sec/veh	Intersection LOS			B

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	158		151		52	776	249	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1653		1699		801	1925	1069	
LnCapacity	569		585		436	1048	581	
Flow Ratio	0.1		0.1		0.1	0.4	0.2	
v/c Ratio	0.28		0.26		0.12	0.74	0.43	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	2.9		2.7		0.6	14.8	3.7	
kB	0.6		0.8		0.4	0.8	0.8	
Q2	0.2		0.3		0.1	2.1	0.6	
Q Average	3.1		3.0		0.7	16.9	4.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.3	1.2	1.2	
BOQ	3.9		3.7		0.9	20.3	5.3	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.7	1.4	1.5	
BOQ	4.8		4.7		1.1	23.8	6.5	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.8		1.9	1.5	1.7	
BOQ	5.5		5.3		1.3	25.6	7.3	
QSRatio								
95th Percentile Output:								
fB%	2.1		2.2		2.5	1.6	2.0	
BOQ	6.6		6.4		1.7	27.6	8.6	
QSRatio								
98th Percentile Output:								
fB%	2.5		2.5		3.0	1.8	2.3	
BOQ	7.8		7.5		2.1	29.5	10.0	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	261							685			351	
Lane Width	16.0							14.5			12.0	
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.43	0.33	25.4	C	25.4	C

Westbound

Northbound

T 2156 3880 0.35 0.56 11.3 B 11.3 B

Southbound

T 1951 3512 0.21 0.56 10.3 B 10.3 B

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	261						685			351		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	73						188			104		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	290						753			418		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	261						685			351		
PHF	0.90						0.91			0.84		
Adj flow	290						753			418		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	290						753			418		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.990				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3880				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	290	2006	# 0.14	0.33	669	0.43
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	753	3880	# 0.19	0.56	2156	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	418	3512	0.12	0.56	1951	0.21
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.34

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.43	0.33	23.4	1.000	669	0.50	2.0	0.0	25.4	C	25.4	C	
Westbound													
Northbound													
T	0.35	0.56	11.0	1.000	2156	0.50	0.3	0.0	11.3	B	11.3	B	
Southbound													
T	0.21	0.56	10.1	1.000	1951	0.50	0.2	0.0	10.3	B	10.3	B	

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdif = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdif / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	23.4	0.00	0.0	0.0	25.4
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.0	0.00	0.0	0.0	11.3
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.1	0.00	0.0	0.0	10.3
	0.0						0.0	
Intersection Delay			13.8	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	290						395		219	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.1						0.2		0.1	
v/c Ratio	0.43						0.35		0.21	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	5.6						5.4		2.8	
kB	0.9						0.8		1.1	
Q2	0.7						0.4		0.3	
Q Average	6.3						5.9		3.1	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.3	
BOQ	7.7						7.2		3.9	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.6	
BOQ	9.4						8.8		4.8	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.7		1.8	
BOQ	10.3						9.7		5.4	
QSRatio										
95th Percentile Output:										
fB%	1.9						1.9		2.1	
BOQ	11.9						11.2		6.6	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.2		2.5	
BOQ	13.4						12.7		7.7	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						351	
Peak-Hour Factor, PHF						0.84	
Hourly Flow Rate, HFR						417	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							55
Peak Hour Factor, PHF							0.70
Hourly Flow Rate, HFR							78
Percent Heavy Vehicles							60
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								78
C(m) (vph)								706
v/c								0.11
95% queue length								0.37
Control Delay								10.7
LOS								B
Approach Delay							10.7	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					351	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					104	
Hourly Flow Rate, HFR					417	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						55
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						20
Hourly Flow Rate, HFR						78
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								208
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		208
Potential Capacity		706
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		706
Probability of Queue free St.	1.00	0.89
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.89	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	595
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	595
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	595	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	595	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	669
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	669

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	832	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.89	1.00
Movement Capacity	740	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.89	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						78
Movement Capacity (vph)						706
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						706
Volume						78
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								78
C(m) (vph)								706
v/c								0.11
95% queue length								0.37
Control Delay								10.7
LOS								B
Approach Delay							10.7	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: KWVP WB Off-Ramp/Mohr St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	46	128	151	186	316	48	71	114	113	4	20	25
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	273	819	0.19	0.33	22.6	C		
TR	577	1732	0.47	0.33	25.9	C	25.4	C
Westbound								
L	262	786	0.82	0.33	50.8	D		
TR	1096	3288	0.38	0.33	23.9	C	33.1	C
Northbound								
LTR	882	3174	0.36	0.28	27.3	C	27.3	C
Southbound								
L	376	1694	0.02	0.22	27.4	C		
TR	351	1579	0.19	0.22	29.6	C	29.4	C

Intersection Delay = 29.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	46	128	151	186	316	48	71	114	113	4	20	25
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	13	36	43	53	91	14	19	31	30	1	7	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	52	273		214	414			321		6	67	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.237			0.000	
Prop RTs		0.469			0.123			0.380			0.552	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	46	128	151	186	316	48	71	114	113	4	20	25
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	52	145	128	214	363	51	76	123	122	6	30	37
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	52	273		214	414			321		6	67	
Prop LTs	1.000	0.000		1.000	0.000			0.237			0.000	
Prop RTs		0.469			0.123			0.380			0.552	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.980	0.980		0.926	0.926		0.926			0.971	0.971	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.930			0.982		0.943				0.917	
fLT	0.455	1.000		0.479	1.000		0.988			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	819	1732		786	3288		3174			1694	1579	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	52	819	0.06	0.33	273	0.19
Prot							
Perm							
Thru	TR	273	1732	0.16	0.33	577	0.47
Right							
Westbound							
Prot							
Perm							
Left	L	214	786	# 0.27	0.33	262	0.82
Prot							
Perm							
Thru	TR	414	3288	0.13	0.33	1096	0.38
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	321	3174	# 0.10	0.28	882	0.36
Right							
Southbound							
Prot							
Perm							
Left	L	6	1694	0.00	0.22	376	0.02
Prot							
Perm							
Thru	TR	67	1579	# 0.04	0.22	351	0.19
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.42$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.50$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.19	0.33	21.4	1.000	273	0.50	1.2	0.0	22.6	C		
TR	0.47	0.33	23.7	1.000	577	0.50	2.2	0.0	25.9	C	25.4	C
Westbound												
L	0.82	0.33	27.5	1.000	262	0.50	23.4	0.0	50.8	D		
TR	0.38	0.33	22.9	1.000	1096	0.50	1.0	0.0	23.9	C	33.1	C
Northbound												
LTR	0.36	0.28	26.1	1.000	882	0.50	1.2	0.0	27.3	C	27.3	C
Southbound												
L	0.02	0.22	27.3	1.000	376	0.50	0.1	0.0	27.4	C		
TR	0.19	0.22	28.4	1.000	351	0.50	1.2	0.0	29.6	C	29.4	C

Intersection delay = 29.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	52	214		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	414	273		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.30	5.35		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.44	6.82		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	3.24	5.73		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.76	24.27		
n=Max(gq-gf)/2,0)	1.62	2.86		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	1.96	1.69		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.45	0.48		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.455	0.479		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.237 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	3.24			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.108			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	414			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.123
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	21.4	0.00	0.0	0.0	22.6
TR	0.0	0.00	30.0	23.7	0.00	0.0	0.0	25.9
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	27.5	0.00	0.0	0.0	50.8
TR	0.0	0.00	30.0	22.9	0.00	0.0	0.0	23.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.1	0.00	0.0	0.0	27.3
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	27.3	0.00	0.0	0.0	27.4
TR	0.0	0.00	35.0	28.4	0.00	0.0	0.0	29.6
	0.0						0.0	
Intersection Delay			29.6	sec/veh	Intersection LOS C			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	52	273		214	217		168			6	67	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	819	1732		786	1726		1667			1694	1579	
LnCapacity	273	577		262	575		463			376	351	
Flow Ratio	0.1	0.2		0.3	0.1		0.1			0.0	0.0	
v/c Ratio	0.19	0.47		0.82	0.38		0.36			0.02	0.19	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	0.9	5.4		4.9	4.1		3.4			0.1	1.4	
kB	0.4	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.1	0.5		1.6	0.5		0.4			0.0	0.1	
Q Average	1.0	5.9		6.5	4.6		3.7			0.1	1.5	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	1.3	7.3		7.9	5.7		4.7			0.2	1.9	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.5	1.5		1.5			1.7	1.6	
BOQ	1.7	8.9		9.6	7.0		5.8			0.2	2.4	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.7		1.6	1.7		1.7			2.0	1.9	
BOQ	1.9	9.8		10.6	7.8		6.5			0.3	2.8	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.9		1.9	2.0		2.1			2.6	2.3	
BOQ	2.4	11.3		12.1	9.2		7.8			0.3	3.5	
QSRatio												
98th Percentile Output:												
fB%	2.9	2.2		2.1	2.3		2.4			3.2	2.8	
BOQ	3.0	12.8		13.6	10.6		9.0			0.4	4.2	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						357			
Peak-Hour Factor, PHF						0.95			
Hourly Flow Rate, HFR						375			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		264							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		283							
Percent Heavy Vehicles		8							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			283							
C(m) (vph)			615							
v/c			0.46							
95% queue length			2.42							
Control Delay			15.7							
LOS			C							
Approach Delay				15.7						
Approach LOS				C						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 357
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 94
 Hourly Flow Rate, HFR 375
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 264
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 71
 Hourly Flow Rate, HFR 283
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	375	
Potential Capacity	615	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	615	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 375
Potential Capacity 615
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 615

Results for Two-stage process:
a
y
C t 615

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	283					
Movement Capacity (vph)	615					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	615					
Volume	283					
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			283					
C(m) (vph)			615					
v/c			0.46					
95% queue length			2.42					
Control Delay			15.7					
LOS			C					
Approach Delay				15.7				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Mohr Street & Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Mohr Street
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	44	17	31	39	0	10	0	20	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.80	0.80	0.78	0.78	0.86	0.86		
Flow Rate	27	48	63	25	11	23		
% Heavy Veh	21	21	1	1	5	5		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	27	48	63	25	11	23		
Left-Turn	0	0	39	0	11	0		
Right-Turn	0	21	0	0	0	23		
Prop. Left-Turns	0.0	0.0	0.6	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

hRT-adj	-0.7		-0.7		-0.6
hHV-adj	1.7		1.7		1.7
hadj, computed	0.4	0.1	0.3	0.0	0.3
					-0.5

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	27	48	63	25	11	23		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.02	0.04	0.06	0.02	0.01	0.02		
hd, final value	4.99	4.69	4.95	4.64	4.56	3.77		
x, final value	0.04	0.06	0.09	0.03	0.01	0.02		
Move-up time, m		2.3		2.3		2.0		
Service Time	2.7	2.4	2.7	2.3	2.6	1.8		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	27	48	63	25	11	23		
Service Time	2.7	2.4	2.7	2.3	2.6	1.8		
Utilization, x	0.04	0.06	0.09	0.03	0.01	0.02		
Dep. headway, hd	4.99	4.69	4.95	4.64	4.56	3.77		
Capacity	277	298	313	275	261	273		
Delay	7.89	7.70	8.12	7.50	7.63	6.86		
LOS	A	A	A	A	A	A		
Approach:								
Delay		7.77		7.95		7.11		
LOS		A		A		A		
Intersection Delay	7.73				Intersection LOS	A		

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	50	23	172	97	243	6	212	69	43	10	91	95
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	1079	2427	0.26	0.44	16.2	B	16.2	B
-----	------	------	------	------	------	---	------	---

Westbound

LTR	1202	2705	0.33	0.44	17.0	B	17.0	B
-----	------	------	------	------	------	---	------	---

Northbound

DefL	497	1119	0.49	0.44	21.2	C		
TR	791	1779	0.16	0.44	15.4	B	19.2	B

Southbound

LTR	1192	2683	0.22	0.44	15.8	B	15.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 17.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	50	23	172	97	243	6	212	69	43	10	91	95
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	14	7	49	28	70	2	61	20	12	3	30	31
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		278			397		244	128			258	
%InSharedLn												
Prop LTs		0.205			0.280		1.000	0.000			0.050	
Prop RTs		0.701			0.018			0.383			0.484	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	50	23	172	97	243	6	212	69	43	10	91	95
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	57	26	195	111	279	7	244	79	49	13	120	125
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	278			397			244 128			258		
Prop LTs	0.205			0.280			1.000 0.000			0.050		
Prop RTs	0.701			0.018			0.383			0.484		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.895			0.997			0.943			0.927		
fLT	0.810			0.772			0.593 1.000			0.942		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2427			2705			1119 1779			2683		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	278	2427	0.11	0.44	1079	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	397	2705	# 0.15	0.44	1202	0.33
Right							
Northbound							
Prot							
Perm							
Left	DefL	244	1119	# 0.22	0.44	497	0.49
Prot							
Perm							
Thru	TR	128	1779	0.07	0.44	791	0.16
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	258	2683	0.10	0.44	1192	0.22
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.26	0.44	15.7	1.000	1079	0.50	0.5	0.0	16.2	B	16.2	B
Westbound												
LTR	0.33	0.44	16.3	1.000	1202	0.50	0.7	0.0	17.0	B	17.0	B
Northbound												
DefL	0.49	0.44	17.8	1.000	497	0.50	3.4	0.0	21.2	C		
TR	0.16	0.44	15.0	1.000	791	0.50	0.4	0.0	15.4	B	19.2	B
Southbound												
LTR	0.22	0.44	15.4	1.000	1192	0.50	0.4	0.0	15.8	B	15.8	B

Intersection delay = 17.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			40.0	
Effective permitted green time for LT lane group, g(s)			40.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			244	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			258	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.10	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			3.39	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.00	
n=Max(gq-gf)/2,0)			0.00	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.69	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.10	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.59	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.593	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	40.0	40.0		40.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0		40.0
Opposing effective green time, go (s)	40.0	40.0		40.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	57	111	13
Proportion of LT in LT lane group, PLT	0.205	0.280	0.000
Proportion of LT in opposing flow, PLTo	0.28	0.21	0.00
Adjusted opposing flow rate, Vo (veh/h)	397	278	128
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.43	2.78	0.33
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.21	3.65	1.60
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	7.8	1.4	22.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	1.55	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.17	38.61	18.03
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	0.72	0.79	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51	0.70	0.10
EL1 (refer to Exhibit C16-3)	2.12	1.87	1.58
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.09	0.06
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71	0.63	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.810	0.772	0.942

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		40.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	1.55	0.00		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.039	0.000		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	397	278		128
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.205	0.280		0.050
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	40.0	40.0	40.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.701	0.018	0.383
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	15.7	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	16.3	0.00	0.0	0.0	17.0
	0.0						0.0	
Northbound								
DefL	0.0	0.00	25.0	17.8	0.00	0.0	0.0	21.2
TR	0.0	0.00	25.0	15.0	0.00	0.0	0.0	15.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	15.4	0.00	0.0	0.0	15.8
	0.0						0.0	
Intersection Delay			17.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	146		208		244	128	135	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0
SL	1274		1420		1119	1779	1409	
LnCapacity	566		631		497	791	626	
Flow Ratio	0.1		0.1		0.2	0.1	0.1	
v/c Ratio	0.26		0.33		0.49	0.16	0.22	
Grn Ratio	0.44		0.44		0.44	0.44	0.44	
I Factor	0.916		0.953			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	2.3		3.4		4.3	1.9	2.1	
kB	0.7		0.8		0.7	1.0	0.8	
Q2	0.2		0.4		0.7	0.2	0.2	
Q Average	2.5		3.8		5.0	2.1	2.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2		1.2	1.3	1.3	
BOQ	3.2		4.7		6.2	2.7	2.9	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.5		1.5	1.6	1.6	
BOQ	4.0		5.8		7.5	3.4	3.7	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.7		1.7	1.8	1.8	
BOQ	4.6		6.5		8.4	3.8	4.2	
QSRatio								
95th Percentile Output:								
fB%	2.2		2.1		2.0	2.3	2.2	
BOQ	5.6		7.8		9.8	4.7	5.1	
QSRatio								
98th Percentile Output:								
fB%	2.6		2.4		2.3	2.7	2.6	
BOQ	6.6		9.1		11.3	5.6	6.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2010
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	729	199	18	4	214	162	4	15	6	88	5	133
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	903	1728	0.89	0.71	20.3	C		
TR	1156	1625	0.21	0.71	4.6	A	16.7	B
Westbound								
LT	448	1833	0.57	0.24	34.6	C	34.1	C
R	383	1568	0.49	0.24	33.3	C		
Northbound								
LTR	354	1991	0.19	0.18	32.7	C	32.7	C
Southbound								
L	226	1271	0.45	0.18	39.3	D		
LT	320	1801	0.02	0.18	30.6	C	19.9	B
R	952	1478	0.16	0.64	6.7	A		

Intersection Delay = 22.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2010
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	729	199	18	4	214	162	4	15	6	88	5	133
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	200	55	5	1	62	47	3	10	4	25	2	38
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0		0				0
Adj Flow	801	239			254	188		68		101	6	153
%InSharedLn										0		
Prop LTs	1.000	0.000			0.020			0.162		1.000	0.000	
Prop RTs		0.084			0.000	1.000		0.235			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603		0.932			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	729	199	18	4	214	162	4	15	6	88	5	133
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	801	219	20	5	249	188	11	41	16	101	6	153
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	801	239			254	188		68		101	6	153
Prop LTs	1.000	0.000			0.020			0.162		1.000	0.000	
Prop RTs		0.084			0.000	1.000		0.235			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.987		1.000	0.850		0.968				1.000	0.850
fLT	0.950	1.000		0.994			0.964			0.731	1.000	
Sec.	0.353											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1625		1833	1568		1991			1271	1801	1478
Sec.	642											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		91	642	# 0.14	0.300	193	0.47
Left	L	801			0.71	903	0.89
Prot							
Perm							
Thru	TR	239	1625	0.15	0.71	1156	0.21
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	254	1833	0.14	0.24	448	0.57
Right	R	188	1568	0.12	0.24	383	0.49
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	68	1991	0.03	0.18	354	0.19
Right							
Southbound							
Prot							
Perm							
Left	L	101	1271	# 0.08	0.18	226	0.45
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	153	1478	0.10	0.64	952	0.16

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.89	0.71	12.2	1.000	903	0.50	8.1	0.0	20.3	C			
TR	0.21	0.71	4.4	1.000	1156	0.50	0.2	0.0	4.6	A	16.7	B	
Westbound													
LT	0.57	0.24	29.8	1.000	448	0.50	4.8	0.0	34.6	C	34.1	C	
R	0.49	0.24	29.2	1.000	383	0.50	4.1	0.0	33.3	C			
Northbound													
LTR	0.19	0.18	31.5	1.000	354	0.50	1.2	0.0	32.7	C	32.7	C	
Southbound													
L	0.45	0.18	33.0	1.000	226	0.50	6.3	0.0	39.3	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	19.9	B	

R 0.16 0.64 6.3 1.000 952 0.50 0.4 0.0 6.7 A

Intersection delay = 22.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	801			101
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.02			0.16
Adjusted opposing flow rate, Vo (veh/h)	254			68
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.02			2.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.35			1.70
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	11.17			1.02
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.83			14.98
n=Max(gq-gf)/2,0)	5.59			0.51
PTHo=1-PLTo	0.98			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.66			1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)	5.34			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	11.17			1.02
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.35			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.353			0.731

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.020	0.162
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	239	6	68
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.97	0.15	1.70
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.02
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.98
n=Max(gq-gf)/2,0)	0.00	0.00	0.51
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.77	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.15	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.02
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.96	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.994	0.964	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		239		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.020		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.084
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	801			
v/c ratio from Capacity Worksheet, X	0.89			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	11.17			
Unopposed green interval, gu	15.83			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.30			
XPerm	1.25			
XProt	0.79			
Case	3			
Queue at beginning of green arrow, Qa	6.98			
Queue at beginning of unsaturated green, Qu	2.49			
Residual queue, Qr	1.19			
Uniform Delay, d1	12.2			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		12.2	0.00	0.0	0.0	20.3
TR	0.0	0.00	13.0	4.4	0.00	0.0	0.0	4.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	29.8	0.00	0.0	0.0	34.6
R	0.0	0.00	34.0	29.2	0.00	0.0	0.0	33.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.7
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.0	0.00	0.0	0.0	39.3
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.7
Intersection Delay			22.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	801	239		254	188		68	101	6	153
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1270	1625		1833	1568		1991	1271	1801	1478
LnCapacity	903	1156		448	383		354	226	320	952
Flow Ratio	0.6	0.1		0.1	0.1		0.0	0.1	0.0	0.1
v/c Ratio	0.89	0.21		0.57	0.49		0.19	0.45	0.02	0.16
Grn Ratio	0.71	0.71		0.24	0.24		0.18	0.18	0.18	0.64
I Factor		0.603		0.932			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	9.1	2.0		5.6	4.0		1.4	2.3	0.1	1.5
kB	0.6	0.8		0.6	0.5		0.6	0.4	0.5	1.1
Q2	3.9	0.2		0.8	0.5		0.1	0.3	0.0	0.2
Q Average	13.0	2.2		6.3	4.5		1.6	2.6	0.1	1.7
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2		1.3	1.3	1.3	1.3
BOQ	15.7	2.8		7.8	5.6		2.0	3.2	0.2	2.2
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5	1.5		1.6	1.6	1.7	1.6
BOQ	18.4	3.5		9.4	6.9		2.6	4.1	0.2	2.8
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.7		1.9	1.8	2.0	1.9
BOQ	19.9	4.0		10.4	7.7		2.9	4.6	0.3	3.2
QSRatio										
95th Percentile Output:										
fB%	1.7	2.2		1.9	2.0		2.3	2.2	2.6	2.3
BOQ	21.7	5.0		11.9	9.1		3.7	5.7	0.3	4.0
QSRatio										
98th Percentile Output:										
fB%	1.8	2.7		2.1	2.3		2.8	2.6	3.2	2.8
BOQ	23.5	5.9		13.5	10.5		4.4	6.7	0.4	4.8
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: AS	Inter.: Boscombe Ave & Tyrellan Ave
Agency: Philip Habib & Associates	Area Type: All other areas
Date: 8/03/2011	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2011 Existing Conditions
Project ID: 1121A - Charleston	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	269	24	0	13	63	35	6	20	10	14	35	311
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	707	1413	0.42	0.50	16.0	B		
TR	1066	2132	0.02	0.50	11.4	B	15.6	B

LTR	1545	3090	0.09	0.50	11.9	B	11.9	B
-----	------	------	------	------	------	---	------	---

LTR	1232	3168	0.06	0.39	17.3	B	17.3	B
-----	------	------	------	------	------	---	------	---

LT	676	1739	0.09	0.39	17.7	B	20.0+	C
R	616	1583	0.33	0.39	20.7	C		

Intersection Delay = 16.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	269	24	0	13	63	35	6	20	10	14	35	311
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
PK 15 Vol	74	7	0	5	22	12	3	11	6	5	12	102
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9		0				155
Adj Flow	296	26			141			79			64	205
%InSharedLn												
Prop LTs	1.000	0.000			0.128			0.165			0.281	
Prop RTs		0.000			0.255			0.278			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.970			1.000			1.000			0.974	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	269	24	0	13	63	35	6	20	10	14	35	311
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	296	26	0	18	87	36	13	44	22	18	46	205
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	296	26			141			79			64	205
Prop LTs	1.000	0.000			0.128			0.165			0.281	
Prop RTs		0.000			0.255			0.278			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.962			0.958		1.000	0.850
fLT	0.663	1.000			0.930			0.923		0.934	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1413	2132			3090			3168		1739	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	296	1413	# 0.21	0.50	707	0.42
Prot							
Perm							
Thru	TR	26	2132	0.01	0.50	1066	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	141	3090	0.05	0.50	1545	0.09
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	79	3168	0.02	0.39	1232	0.06
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	64	1739	0.04	0.39	676	0.09
Right	R	205	1583	# 0.13	0.39	616	0.33

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.42	0.50	14.2	1.000	707	0.50	1.8	0.0	16.0	B			
TR	0.02	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.4	B	15.6	B	
Westbound													
LTR	0.09	0.50	11.8	1.000	1545	0.50	0.1	0.0	11.9	B	11.9	B	
Northbound													
LTR	0.06	0.39	17.2	1.000	1232	0.50	0.1	0.0	17.3	B	17.3	B	
Southbound													
LT	0.09	0.39	17.4	1.000	676	0.50	0.3	0.0	17.7	B	20.0+	C	

R 0.33 0.39 19.3 1.000 616 0.50 1.4 0.0 20.7 C

Intersection delay = 16.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	296			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.13			
Adjusted opposing flow rate, Vo (veh/h)	141			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	7.40			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.85			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.87			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.51			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.663			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No		2	1	2
Adjusted LT flow rate, VLT (veh/h)		18	13	18
Proportion of LT in LT lane group, PLT	0.000	0.128	0.165	0.281
Proportion of LT in opposing flow, PLTo		0.00	0.28	0.16
Adjusted opposing flow rate, Vo (veh/h)		26	64	79
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		0.45	0.33	0.45
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.32	1.60	1.04
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.4	18.6	16.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		22.64	16.40	18.72
n=Max(gq-gf)/2,0)		0.00	0.00	0.00
PTHo=1-PLTo		1.00	0.72	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.26	0.33	0.28
EL1 (refer to Exhibit C16-3)		1.41	1.47	1.50
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	0.08	0.07
gdifff=max(gq-gf,0)		0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	0.94	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.930	0.923	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	141	26	64	79
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.128	0.165	0.281
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.255	0.278	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	14.2	0.00	0.0	0.0	16.0
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.2	0.00	0.0	0.0	17.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.4	0.00	0.0	0.0	17.7
R	0.0	0.00	27.5	19.3	0.00	0.0	0.0	20.7
Intersection Delay			16.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	296	26			74			41			64	205
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1413	2132			1622			1663			1739	1583
LnCapacity	707	1066			811			647			676	616
Flow Ratio	0.2	0.0			0.0			0.0			0.0	0.1
v/c Ratio	0.42	0.02			0.09			0.06			0.09	0.33
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.970			1.000			1.000			0.974	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	4.7	0.3			1.0			0.6			1.0	3.6
kB	0.9	1.2			1.0			0.8			0.8	0.8
Q2	0.6	0.0			0.1			0.1			0.1	0.4
Q Average	5.3	0.4			1.1			0.7			1.1	4.0
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	6.5	0.5			1.4			0.9			1.4	5.0
QSRatio												
85th Percentile Output:												
fB%	1.5	1.7			1.6			1.7			1.6	1.5
BOQ	8.0	0.6			1.8			1.2			1.8	6.1
QSRatio												
90th Percentile Output:												
fB%	1.7	2.0			1.9			1.9			1.9	1.7
BOQ	8.9	0.7			2.0			1.4			2.1	6.9
QSRatio												
95th Percentile Output:												
fB%	1.9	2.5			2.4			2.5			2.4	2.1
BOQ	10.3	0.9			2.6			1.7			2.7	8.2
QSRatio												
98th Percentile Output:												
fB%	2.2	3.1			2.9			3.0			2.9	2.4
BOQ	11.8	1.1			3.1			2.1			3.2	9.5
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	60		4				4	72			173	342
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.14	0.32	15.2	B	15.2	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								
Northbound								
LT	1679	3249	0.06	0.52	7.3	A	7.3	A
Southbound								
TR	1888	3655	0.34	0.52	8.8	A	8.8	A

Intersection Delay = 9.3 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60		4				4	72		173	342	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	19		1				1	22		53	106	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	75		0					95			636	
%InSharedLn												
Prop LTs								0.053			0.000	
Prop RTs			1.000					0.000			0.664	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995					1.000			0.752		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60		4				4	72		173	342	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	75		0				5	90		214	422	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	75		0					95			636	
Prop LTs								0.053			0.000	
Prop RTs			1.000					0.000			0.664	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.900	
fLT	0.950				0.932		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3249		3655	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	75	1680	# 0.04	0.32	532	0.14
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	95	3249	0.03	0.52	1679	0.06
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	636	3655	# 0.17	0.52	1888	0.34
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.22$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.26$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.14	0.32	14.7	1.000	532	0.50	0.6	0.0	15.2	B	15.2	B	
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B			
Westbound													
Northbound													
LT	0.06	0.52	7.2	1.000	1679	0.50	0.1	0.0	7.3	A	7.3	A	
Southbound													
TR	0.34	0.52	8.5	1.000	1888	0.50	0.4	0.0	8.8	A	8.8	A	

Intersection delay = 9.3 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.053 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	636
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.57
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	1.61
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.11
EL1 (refer to Exhibit C16-3)	2.71
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.932

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			1.61	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.052	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			636	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.053	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.664
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	14.7	0.00	0.0	0.0	15.2
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.2	0.00	0.0	0.0	7.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	8.5	0.00	0.0	0.0	8.8
	0.0						0.0	
Intersection Delay			9.3	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	75	0				49		334	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1706		1919	
LnCapacity	532	461				881		991	
Flow Ratio	0.0	0.0				0.0		0.2	
v/c Ratio	0.14	0.00				0.06		0.34	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	0.9	0.0				0.4		3.3	
kB	0.6	0.5				0.8		0.6	
Q2	0.1	0.0				0.0		0.3	
Q Average	1.0	0.0				0.5		3.6	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	1.3	0.0				0.6		4.5	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	1.6	0.0				0.8		5.5	
QSRatio									
90th Percentile Output:									
fB%	1.9	2.0				2.0		1.7	
BOQ	1.9	0.0				0.9		6.3	
QSRatio									
95th Percentile Output:									
fB%	2.4	2.6				2.5		2.1	
BOQ	2.4	0.0				1.1		7.5	
QSRatio									
98th Percentile Output:									
fB%	2.9	3.2				3.1		2.4	
BOQ	2.9	0.0				1.4		8.7	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L	LT		L	LTR				
Volume	1	0		390	1		3			22	125	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.41	0.42	14.4	B		
LT	576	1382	0.43	0.42	14.7	B	14.6	B

Northbound

L	463	1111	0.01	0.42	10.3	B	10.3	B
---	-----	------	------	------	------	---	------	---

Southbound

LTR	2049	4917	0.09	0.42	10.7	B	10.7	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		390	1		3			22	125	0
% Heavy Veh	2	2		3	3		1			1	1	1
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol	1	0		123	1		1			7	39	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			247	248		4			181		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.996		1.000				0.149	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.981			0.998		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		390	1		3			22	125	0
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	4	0		494	1		4			27	154	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			247	248		4			181		
Prop LTs	0.000			1.000 0.996			1.000			0.149		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.633		0.993	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1439 1382		1111		4917	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1863	0.00	0.42	776	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	247	1439	0.17	0.42	600	0.41
Prot							
Perm							
Thru	LT	248	1382	# 0.18	0.42	576	0.43
Right							
Northbound							
Prot							
Perm							
Left	L	4	1111	0.00	0.42	463	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	181	4917	# 0.04	0.42	2049	0.09
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.22
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.26

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	776	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.41	0.42	12.3	1.000	600	0.50	2.0	0.0	14.4	B			
LT	0.43	0.42	12.4	1.000	576	0.50	2.3	0.0	14.7	B	14.6	B	
Northbound													
L	0.01	0.42	10.2	1.000	463	0.50	0.0	0.0	10.3	B	10.3	B	
Southbound													
LTR	0.09	0.42	10.6	1.000	2049	0.50	0.1	0.0	10.7	B	10.7	B	

Intersection delay = 13.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		247	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.15	
Adjusted opposing flow rate, Vo (veh/h)		4	181	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.12	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	1.11	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	25.00	
n=Max(gq-gf)/2,0)		0.00	0.00	
PTHo=1-PLTo		1.00	0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	1.58	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.63	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.633	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	247		
Proportion of LT in LT lane group, PLT	0.000	0.996	0.149
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.12		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		247	248	4		66	
So	1900		1900	1900	1900		1900	
No.Lanes	0	1	0	1	0	0	0	3
SL	1863		1439	1382	1111		1805	
LnCapacity	776		600	576	463		752	
Flow Ratio	0.0		0.2	0.2	0.0		0.0	
v/c Ratio	0.01		0.41	0.43	0.01		0.09	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.981		0.998	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		2.9	2.9	0.0		0.7	
kB	0.7		0.6	0.6	0.5		0.7	
Q2	0.0		0.4	0.4	0.0		0.1	
Q Average	0.0		3.3	3.4	0.0		0.7	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3	1.3	1.3		1.3	
BOQ	0.1		4.1	4.2	0.1		0.9	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.6	1.6	1.7		1.7	
BOQ	0.1		5.1	5.2	0.1		1.2	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.8	1.8	2.0		1.9	
BOQ	0.1		5.8	5.9	0.1		1.4	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.1	2.6		2.5	
BOQ	0.1		7.0	7.1	0.1		1.8	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.5	2.5	3.2		3.0	
BOQ	0.1		8.2	8.3	0.1		2.2	
QSRatio								

ERROR MESSAGES

No errors to report.

Vehicle Volumes and Adjustments

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			129			
Peak Hour Factor, PHF			0.78			
Hourly Flow Rate, HFR			165			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach:	Exists?/Storage			/		/
Lanes			1			
Configuration			R			

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					165			
C(m) (vph)					1050			
v/c					0.16			
95% queue length					0.56			
Control Delay					9.1			
LOS					A			
Approach Delay				9.1				
Approach LOS				A				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		7				
Hourly Flow Rate, HFR		28				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			129			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			41			
Hourly Flow Rate, HFR			165			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					28			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	28	
Potential Capacity	1050	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1050	
Probability of Queue free St.	0.84	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.84
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Result for 2 stage process:

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Results for Two-stage process:

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1050			
Volume			165			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					165			
C(m) (vph)					1050			
v/c					0.16			
95% queue length					0.56			
Control Delay					9.1			
LOS					A			
Approach Delay				9.1				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 7/28/2011
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	52	20	65	65	0	0	0	0	10	62	26
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	88		164				50 70	
% Heavy Veh	24		5				3 3	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	88		164				50	70
Left-Turn	0		82				12	0
Right-Turn	24		0				0	32
Prop. Left-Turns	0.0		0.5				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.5
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

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Phone:
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-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 7/28/2011
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	56	0	0	76	54	54	49	38	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	76		164		89		71	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	76		164		89	71		
Left-Turn	7		0		62	0		
Right-Turn	0		68		0	43		
Prop. Left-Turns	0.1		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.4		0.0	0.6		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.3	-0.1	0.2 -0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	76		164		89	71		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.07		0.15		0.08	0.06		
hd, final value	4.74		4.22		4.61	4.10		
x, final value	0.10		0.19		0.11	0.08		
Move-up time, m		2.0		2.0		2.0		
Service Time	2.7		2.2		2.6	2.1		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	76		164		89	71		
Service Time	2.7		2.2		2.6	2.1		
Utilization, x	0.10		0.19		0.11	0.08		
Dep. headway, hd	4.74		4.22		4.61	4.10		
Capacity	326		414		339	321		
Delay	8.26		8.21		8.20	7.46		
LOS	A		A		A	A		
Approach:								
Delay		8.26		8.21		7.87		
LOS		A		A		A		
Intersection Delay	8.09							

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	69	41	42	6	37	1	354	71	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	533	1522	0.26	0.35	15.1	B	14.8	B
R	549	1568	0.05	0.35	13.1	B		

Westbound

LTR	546	1561	0.10	0.35	13.5	B	13.5	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2253	4662	0.25	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	69	41	42	6	37	1	354	71	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	22	13	13	2	12	1	116	23	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		139	27		56			560				
%InSharedLn												
Prop LTs		0.626			0.143			0.832				
Prop RTs		0.000	1.000		0.018			0.002				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	69	41	42	6	37	1	354	71	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	87	52	27	8	47	1	466	93	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	139 27			56			560					
Prop LTs	0.626			0.143			0.832					
Prop RTs	0.000 1.000			0.018			0.002					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.971	0.971		0.990			0.971	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.998			1.000	
fLT	0.799			0.967			0.960	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1522	1568		1561			4662	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.26	0.35	13.9	1.000	533	0.50	1.2	0.0	15.1	B	14.8	B
R	0.05	0.35	12.9	1.000	549	0.50	0.2	0.0	13.1	B		
Westbound												
LTR	0.10	0.35	13.1	1.000	546	0.50	0.4	0.0	13.5	B	13.5	B
Northbound												
LTR	0.25	0.48	9.1	1.000	2253	0.50	0.3	0.0	9.4	A	9.4	A
Southbound												

Intersection delay = 10.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	87	8	
Proportion of LT in LT lane group, PLT	0.626	0.143	0.832
Proportion of LT in opposing flow, PLTo	0.14	0.63	
Adjusted opposing flow rate, Vo (veh/h)	56	139	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.45	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.93	2.32	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	2.1	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.94	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.91	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.86	0.37	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.63	0.14	
EL1 (refer to Exhibit C16-3)	1.46	1.59	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.80	0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.799	0.967	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	0.94		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.045		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	56	139	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.626	0.143	0.832	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.018	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	13.9	0.00	0.0	0.0	15.1
R	0.0	0.00	19.5	12.9	0.00	0.0	0.0	13.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.1	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			10.8	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LT	R			LTR			LTR			
Init Queue		0.0	0.0			0.0			0.0			
Flow Rate		139	27			56			205			
So		1900	1900			1900			1900			
No.Lanes	0	1	1	0		1	0	0	3	0	0	0
SL		1522	1568			1561			1711			
LnCapacity		533	549			546			827			
Flow Ratio		0.1	0.0			0.0			0.1			
v/c Ratio		0.26	0.05			0.10			0.25			
Grn Ratio		0.35	0.35			0.35			0.48			
I Factor		0.999				0.998			0.978			
AT or PVG		3	3			3			3			
Pltn Ratio		1.00	1.00			1.00			1.00			
PF2		1.00	1.00			1.00			1.00			
Q1		1.7	0.3			0.6			2.0			
kB		0.6	0.6			0.6			0.7			
Q2		0.2	0.0			0.1			0.2			
Q Average		1.9	0.3			0.7			2.2			
Q Spacing		25.0	25.0			25.0			25.0			
Q Storage		0	0			0			0			
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3			1.3			1.3			
BOQ		2.3	0.4			0.9			2.8			
QSRatio												
85th Percentile Output:												
fB%		1.6	1.7			1.7			1.6			
BOQ		3.0	0.5			1.2			3.6			
QSRatio												
90th Percentile Output:												
fB%		1.8	2.0			1.9			1.8			
BOQ		3.4	0.6			1.3			4.1			
QSRatio												
95th Percentile Output:												
fB%		2.3	2.5			2.5			2.2			
BOQ		4.2	0.8			1.7			5.0			
QSRatio												
98th Percentile Output:												
fB%		2.7	3.1			3.0			2.7			
BOQ		5.1	1.0			2.1			6.0			
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 7/28/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	24		17				15	319		29	439	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	456	1710	0.12	0.27	17.2	B	17.2	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1014	1789	0.37	0.57	8.1	A	8.1	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	970	1712	0.56	0.57	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 9.8 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24		17				15	319		29	439	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	8		6				4	90		8	128	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		55						375			544	
%InSharedLn												
Prop LTs		0.582						0.045			0.000	
Prop RTs		0.418						0.000			0.938	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	24		17				15	319		29	439	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	32		23				17	358		34	510	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		55						375			544	
Prop LTs		0.582						0.045			0.000	
Prop RTs	0.418						0.000			0.938		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.944						1.000			0.873		
fLT	0.972						0.972			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1710						1789			1712		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	55	1710	# 0.03	0.27	456	0.12
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	375	1789	0.21	0.57	1014	0.37
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	544	1712	# 0.32	0.57	970	0.56
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.12	0.27	16.7	1.000	456	0.50	0.5	0.0	17.2	B	17.2	B
Westbound												
Northbound												
LT	0.37	0.57	7.1	1.000	1014	0.50	1.0	0.0	8.1	A	8.1	A
Southbound												
TR	0.56	0.57	8.3	1.000	970	0.50	1.9	0.0	10.2	B	10.2	B

Intersection delay = 9.8 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		17	
Proportion of LT in LT lane group, PLT	0.582	0.045	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		544	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.28	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		5.92	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.96	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdif=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.972	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.92	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.174	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			544	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.045	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.938
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	16.7	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.1	0.00	0.0	0.0	8.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.2
	0.0						0.0	
Intersection Delay			9.8	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	55						375			544		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1710						1789			1712		
LnCapacity	456						1014			970		
Flow Ratio	0.0						0.2			0.3		
v/c Ratio	0.12						0.37			0.56		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	0.7						3.4			5.8		
kB	0.5						0.8			0.7		
Q2	0.1						0.5			0.9		
Q Average	0.8						3.9			6.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	1.0						4.9			8.1		
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.5		
BOQ	1.3						6.0			9.8		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.6		
BOQ	1.5						6.7			10.8		
QSRatio												
95th Percentile Output:												
fB%	2.5						2.1			1.9		
BOQ	1.9						8.0			12.3		
QSRatio												
98th Percentile Output:												
fB%	3.0						2.4			2.1		
BOQ	2.3						9.3			13.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 7/28/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	45		49				28	327		266		65
Lane Width		16.0						16.0		16.0		
RTOR Vol			0									17

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0					30.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	500	1501	0.23	0.33	15.5	B	15.5	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	811	1622	0.49	0.50	11.8	B	11.8	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	943	1885	0.39	0.50	10.4	B	10.4	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 11.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	45		49				28	327		266	65	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	14		15				8	92		77	19	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		117						398			365	
%InSharedLn												
Prop LTs		0.479						0.078			0.000	
Prop RTs		0.521						0.000			0.153	
Peds Bikes	0	0		0						0	0	
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	45		49				28	327		266	65	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	56		61				31	367		309	56	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		117						398			365	
Prop LTs		0.479						0.078			0.000	
Prop RTs	0.521						0.000			0.153		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.930						1.000			0.979		
fLT	0.977						0.956			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1501						1622			1885		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	117	1501	# 0.08	0.33	500	0.23
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	398	1622	# 0.25	0.50	811	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	365	1885	0.19	0.50	943	0.39
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.32

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.23	0.33	14.5	1.000	500	0.50	1.1	0.0	15.5	B	15.5	B
Westbound												
Northbound												
LT	0.49	0.50	9.9	1.000	811	0.50	1.8	0.0	11.8	B	11.8	B
Southbound												
TR	0.39	0.50	9.3	1.000	943	0.50	1.1	0.0	10.4	B	10.4	B

Intersection delay = 11.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		31	
Proportion of LT in LT lane group, PLT	0.479	0.078	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		365	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.52	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.08	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		12.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		4.38	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.99	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.08	
EL1 (refer to Exhibit C16-3)		2.01	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.956	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			4.38	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.146	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		365	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.479		0.078	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.521	0.153
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.5	0.00	0.0	0.0	15.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	9.9	0.00	0.0	0.0	11.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	9.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Intersection Delay			11.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	117						398			365		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1501						1622			1885		
LnCapacity	500						811			943		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.23						0.49			0.39		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.4						4.4			3.8		
kB	0.5						0.6			0.8		
Q2	0.2						0.6			0.5		
Q Average	1.6						5.0			4.3		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.0						6.2			5.3		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	2.5						7.6			6.5		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7		
BOQ	2.9						8.4			7.3		
QSRatio												
95th Percentile Output:												
fB%	2.3						2.0			2.0		
BOQ	3.7						9.9			8.6		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.3			2.3		
BOQ	4.4						11.3			10.0		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Vets Rd E & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/28/2011 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		54	218	367	152	39	179		436	20	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	27.0	C
R	216	1620	0.31	0.13	27.2	C		
Westbound								
LTR	1314	4638	0.64	0.28	20.5	C	20.5	C
Northbound								
L	120	355	0.36	0.33	22.9	C		
T	575	1726	0.35	0.33	16.6	B	17.7	B
Southbound								
TR	662	1985	0.91	0.33	25.8	C	25.8	C

Intersection Delay = 22.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		54	218	367	152	39	179		436	20	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		17	62	104	43	11	50		143	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		68		838		43	199			600	
%InSharedLn												
Prop LTs					0.296		1.000	0.000			0.000	
Prop RTs			1.000		0.206			0.000		0.043		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		54	218	367	152	39	179		436	20	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		68	248	417	173	43	199		574	26	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		68		838		43	199		600		
Prop LTs					0.296		1.000	0.000		0.000		
Prop RTs			1.000		0.206			0.000		0.043		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.971	0.971	0.971		0.935	0.935	0.935	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.972	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.969			1.000	0.994	
fLT	0.950		0.985		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1636	1620	4638		355	1726	1985	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	68	1620	# 0.04	0.13	216	0.31
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	838	4638	# 0.18	0.28	1314	0.64
Right							
Northbound							
Prot							
Perm							
Left	L	43	355	0.12	0.33	120	0.36
Prot							
Perm							
Thru	T	199	1726	0.12	0.33	575	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	600	1985	# 0.30	0.33	662	0.91
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	27.0	C	
R	0.31	0.13	23.5	1.000	216	0.50	3.7	0.0	27.2	C			
Westbound													
LTR	0.64	0.28	18.8	1.000	1314	0.50	1.7	0.0	20.5	C	20.5	C	
Northbound													
L	0.36	0.33	15.1	1.000	120	0.50	7.7	0.0	22.9	C	17.7	B	
T	0.35	0.33	15.1	1.000	575	0.50	1.6	0.0	16.6	B			
Southbound													
TR	0.91	0.33	19.1	1.000	662	0.50	6.7	0.0	25.8	C	25.8	C	

Intersection delay = 22.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			43	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			600	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			0.72	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.00	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			13.58	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			6.42	
n=Max(gq-gf)/2,0)			6.79	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.28	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.296 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			13.58	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.679	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			600	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.206	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	23.5	0.00	0.0	0.0	27.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	18.8	0.00	0.0	0.0	20.5
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.1	0.00	0.0	0.0	22.9
T	0.0	0.00	20.0	15.1	0.00	0.0	0.0	16.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.1	0.00	0.0	0.0	25.8
	0.0						0.0	
Intersection Delay			22.2	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	68		307		43	199		600
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1636	1620		1702		355	1726		1985
LnCapacity	218	216		482		120	575		662
Flow Ratio	0.0	0.0		0.2		0.1	0.1		0.3
v/c Ratio	0.02	0.31		0.64		0.36	0.35		0.91
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.0		4.5		0.5	2.5		9.6
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	0.1		0.6		0.1	0.3		1.5
Q Average	0.1	1.2		5.1		0.6	2.8		11.1
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	1.5		6.3		0.8	3.5		13.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.7	1.6		1.4
BOQ	0.1	1.9		7.7		1.1	4.4		15.9
QSRatio									
90th Percentile Output:									
fB%	2.0	1.9		1.7		1.9	1.8		1.6
BOQ	0.1	2.2		8.6		1.2	5.0		17.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.4		2.0		2.5	2.2		1.7
BOQ	0.2	2.8		10.0		1.6	6.1		18.9
QSRatio									
98th Percentile Output:									
fB%	3.2	2.9		2.2		3.0	2.6		1.9
BOQ	0.2	3.3		11.4		1.9	7.1		20.6
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: S Service Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/28/2011 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	11	36	10				5	207	81	241	437	30
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 457 1612 0.15 0.28 16.8 B 16.8 B

Westbound

Northbound

LTR 899 1634 0.36 0.55 8.7 A 8.7 A

Southbound

L 565 1027 0.53 0.55 10.5 B
 TR 960 1745 0.61 0.55 10.6 B 10.6 B

Intersection Delay = 10.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	11	36	10				5	207	81	241	437	30
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	3	11	3				2	58	23	75	137	9
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		67						326		301	583	
%InSharedLn												
Prop LTs		0.194						0.018		1.000	0.000	
Prop RTs		0.179						0.276			0.063	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	11	36	10				5	207	81	241	437	30
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	13	42	12				6	230	90	301	546	37
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	67						326			301	583	
Prop LTs	0.194						0.018			1.000	0.000	
Prop RTs	0.179						0.276			0.063		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW		1.033						1.133		1.000	1.000	
fHV		0.971						0.935		0.935	0.935	
fG		1.000						1.000		1.000	1.000	
fP		0.875						0.875		1.000	1.000	
fBB		1.000						0.972		1.000	0.992	
fA		1.000						1.000		1.000	1.000	
fLU		1.000						1.000		1.000	1.000	
fRT		0.976						0.963			0.990	
fLT		0.990						0.992		0.578	1.000	
Sec.												
fLpb		1.000						1.000		1.000	1.000	
fRpb		1.000						1.000			1.000	
S		1612						1634		1027	1745	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	67	1612	# 0.04	0.28	457	0.15
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	326	1634	0.20	0.55	899	0.36
Right							
Southbound							
Prot							
Perm							
Left	L	301	1027	0.29	0.55	565	0.53
Prot							
Perm							
Thru	TR	583	1745	# 0.33	0.55	960	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.15	0.28	16.1	1.000	457	0.50	0.7	0.0	16.8	B	16.8	B
Westbound												
Northbound												
LTR	0.36	0.55	7.6	1.000	899	0.50	1.1	0.0	8.7	A	8.7	A
Southbound												
L	0.53	0.55	8.6	1.000	565	0.50	1.9	0.0	10.5	B		
TR	0.61	0.55	9.1	1.000	960	0.50	1.5	0.0	10.6	B	10.6	B

Intersection delay = 10.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				301
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				326
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.02
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				5.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				2.69
gu=g-gq if gq>=gf, or = g-gf if gq<gf				30.31
n=Max(gq-gf)/2,0)				1.35
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.77
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.34
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				2.69
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.58
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.578

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		6	
Proportion of LT in LT lane group, PLT	0.194	0.018	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		583	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.10	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.72	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		6.98	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.14	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.50	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.98	2.69
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.212	0.082
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			583	326
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.018	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.179	0.276	0.063
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.8
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.6	0.00	0.0	0.0	8.7
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.6	0.00	0.0	0.0	10.5
TR	0.0	0.00	13.5	9.1	0.00	0.0	0.0	10.6
	0.0						0.0	

Intersection Delay	10.4	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		67						326			301	583
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1612						1634			1027	1745
LnCapacity		457						899			565	960
Flow Ratio		0.0						0.2			0.3	0.3
v/c Ratio		0.15						0.36			0.53	0.61
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.941				0.518
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.8						3.1			3.2	6.6
kB		0.5						0.8			0.3	0.4
Q2		0.1						0.4			0.3	0.7
Q Average		0.9						3.5			3.5	7.2
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.2						4.3			4.4	8.8
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		1.5						5.4			5.5	10.6
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.8						6.1			6.2	11.7
QSRatio												
95th Percentile Output:												
fB%		2.4						2.1			2.1	1.8
BOQ		2.2						7.3			7.4	13.3
QSRatio												
98th Percentile Output:												
fB%		2.9						2.4			2.4	2.1
BOQ		2.7						8.5			8.6	14.8
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Amboy Rd & Bloomingdale Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/28/2011 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	19	12	160	15	97	9	154	122	129	266	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 651 1464 0.09 0.44 14.7 B 14.7 B

Westbound

L 549 1236 0.33 0.44 17.9 B
 T 777 1749 0.02 0.44 14.1 B 16.9 B
 R 574 1291 0.19 0.44 15.9 B

Northbound

LTR 689 1550 0.46 0.44 19.3 B 19.3 B

Southbound

LTR 566 1273 0.94 0.44 27.6 C 27.6 C

Intersection Delay = 22.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	19	12	160	15	97	9	154	122	129	266	8
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	4	45	4	28	3	43	34	42	88	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		56		182	17	110		317			531	
%InSharedLn												
Prop LTs		0.179		1.000	0.000			0.032			0.320	
Prop RTs		0.321			0.000	1.000		0.429			0.021	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000				0.966		0.850			0.090		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5				11.8		18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	19	12	160	15	97	9	154	122	129	266	8
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	10	28	18	182	17	110	10	171	136	170	350	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	56			182 17 110			317			531		
Prop LTs	0.179			1.000 0.000			0.032			0.320		
Prop RTs	0.321			0.000 1.000			0.429			0.021		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L T R			LTR			LTR		
So	1900			1900 1900 1900			1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000 0.967 0.967			0.967			1.000		
fHV	0.971			0.952 0.952 0.952			0.935			0.935		
fG	1.000			1.000 1.000 1.000			1.000			1.000		
fP	0.875			1.000 1.000 0.875			1.000			1.000		
fBB	0.992			1.000 1.000 0.992			1.000			1.000		
fA	1.000			1.000 1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000 1.000			1.000			1.000		
fRT	0.957			1.000 0.850			0.942			0.997		
fLT	0.973			0.720 1.000			0.982			0.726		
Sec.												
fLpb	1.000			0.948 1.000			1.000			0.990		
fRpb	0.982			1.000 1.000			0.976			1.000		
S	1464			1236 1749 1291			1550			1273		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	56	1464	0.04	0.44	651	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	182	1236	# 0.15	0.44	549	0.33
Prot							
Perm							
Thru	T	17	1749	0.01	0.44	777	0.02
Right	R	110	1291	0.09	0.44	574	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	317	1550	0.20	0.44	689	0.46
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	531	1273	# 0.42	0.44	566	0.94
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.4	1.000	651	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.33	0.44	16.3	1.000	549	0.50	1.6	0.0	17.9	B		
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B	16.9	B
R	0.19	0.44	15.2	1.000	574	0.50	0.7	0.0	15.9	B		
Northbound												
LTR	0.46	0.44	17.5	1.000	689	0.50	1.9	0.0	19.3	B	19.3	B
Southbound												
LTR	0.94	0.44	23.8	1.000	566	0.50	3.8	0.0	27.6	C	27.6	C

Intersection delay = 22.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		182		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.18		
Adjusted opposing flow rate, Vo (veh/h)		56		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		4.55		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.40		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.82		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	10	170
Proportion of LT in LT lane group, PLT	0.179	0.000	0.032
Proportion of LT in opposing flow, PLTo	0.00	0.32	0.03
Adjusted opposing flow rate, Vo (veh/h)	17	531	317
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.25	4.25
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.43	13.27	7.93
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	22.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.01	7.83
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	17.08	32.17
n=Max(gq-gf)/2,0)	0.00	0.00	3.91
PTHo=1-PLTo	1.00	0.68	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.18	0.03	0.32
EL1 (refer to Exhibit C16-3)	1.40	2.37	1.91
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	3.74
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.07
gdifff=max(gq-gf,0)	0.00	0.00	7.83
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.98	0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.973	0.982	0.726

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.01	7.83
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.350	0.196
OCCpedu	0.000	0.056	0.000	0.051
Opposing flow rate, Vo (veh/h)	17	56	531	317
OCCr	0.000	0.052	0.000	0.033
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.967
Proportion of left turns, PLT	0.179	1.000	0.032	0.320
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.990
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.321	1.000	0.429	0.021
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.976	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.4	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	16.3	0.00	0.0	0.0	17.9
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.9
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	17.5	0.00	0.0	0.0	19.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	23.8	0.00	0.0	0.0	27.6
	0.0						0.0	
Intersection Delay			22.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		56	182	17	110		317		531
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1464	1236	1749	1291		1550		1273
LnCapacity		651	549	777	574		689		566
Flow Ratio		0.0	0.1	0.0	0.1		0.2		0.4
v/c Ratio		0.09	0.33	0.02	0.19		0.46		0.94
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	3.0	0.2	1.7		5.5		12.6
kB		0.8	0.7	0.9	0.7		0.7		0.1
Q2		0.1	0.4	0.0	0.2		0.6		0.9
Q Average		0.9	3.3	0.3	1.8		6.2		13.5
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.3	1.3	1.3		1.2		1.2
BOQ		1.1	4.2	0.3	2.3		7.6		16.3
QSRatio									
85th Percentile Output:									
fB%		1.7	1.6	1.7	1.6		1.5		1.4
BOQ		1.5	5.2	0.4	3.0		9.2		19.2
QSRatio									
90th Percentile Output:									
fB%		1.9	1.8	2.0	1.8		1.6		1.5
BOQ		1.7	5.8	0.5	3.4		10.1		20.7
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.9		1.7
BOQ		2.2	7.0	0.7	4.2		11.7		22.5
QSRatio									
98th Percentile Output:									
fB%		3.0	2.5	3.1	2.7		2.1		1.8
BOQ		2.6	8.2	0.8	5.1		13.2		24.3
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 7/28/2011
 Period: Weekday 8-9 AM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	118		175	28	140		209		44			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left		P			SB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	891	1782	0.30	0.50	14.1	B	14.1	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	881	1762	0.21	0.50	13.1	B	13.1	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	538	1383	0.50	0.39	23.7	C	23.7	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 17.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		118	175	28	140		209		44			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		32	48	8	39		56		12			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		270			188			269				
%InSharedLn												
Prop LTs		0.000			0.165			0.825				
Prop RTs		0.526			0.000			0.175				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	118	175		28	140		209		44			
PHF	0.92	0.92		0.89	0.89		0.94		0.94			
Adj flow	128	142		31	157		222		47			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group	TR			LT			LR					
Adj flow	270			188			269					
Prop LTs	0.000			0.165			0.825					
Prop RTs	0.526			0.000			0.175					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.929			1.000			0.976					
fLT	1.000			0.925			0.960					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1782			1762			1383					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	270	1782	# 0.15	0.50	891	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	188	1762	0.11	0.50	881	0.21
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	269	1383	# 0.19	0.39	538	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.30	0.50	13.3	1.000	891	0.50	0.8	0.0	14.1	B	14.1	B
Westbound												
LT	0.21	0.50	12.6	1.000	881	0.50	0.5	0.0	13.1	B	13.1	B
Northbound												
LR	0.50	0.39	20.9	1.000	538	0.50	2.8	0.0	23.7	C	23.7	C
Southbound												

Intersection delay = 17.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	31		
Proportion of LT in LT lane group, PLT	0.000	0.165	0.825
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	270		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	0.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.75		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.6		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	5.15		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.37		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16		
EL1 (refer to Exhibit C16-3)	1.82		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.92		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.925		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.3	0.00	0.0	0.0	14.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	12.6	0.00	0.0	0.0	13.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	20.9	0.00	0.0	0.0	23.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			17.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	TR			LT			LR					
Init Queue	0.0			0.0			0.0					
Flow Rate	270			188			269					
So	1900			1900			1900					
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	
SL	1782			1762			1383					
LnCapacity	891			881			538					
Flow Ratio	0.2			0.1			0.2					
v/c Ratio	0.30			0.21			0.50					
Grn Ratio	0.50			0.50			0.39					
I Factor	0.964			0.986			0.858					
AT or PVG	3			3			3					
Pltn Ratio	1.00			1.00			1.00					
PF2	1.00			1.00			1.00					
Q1	4.0			2.6			5.1					
kB	1.0			1.0			0.6					
Q2	0.4			0.3			0.6					
Q Average	4.4			2.9			5.7					
Q Spacing	25.0			25.0			25.0					
Q Storage	0			0			0					
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.3			1.2					
BOQ	5.5			3.7			7.1					
QSRatio												
85th Percentile Output:												
fB%	1.5			1.6			1.5					
BOQ	6.7			4.6			8.6					
QSRatio												
90th Percentile Output:												
fB%	1.7			1.8			1.7					
BOQ	7.5			5.2			9.5					
QSRatio												
95th Percentile Output:												
fB%	2.0			2.2			1.9					
BOQ	8.9			6.3			11.0					
QSRatio												
98th Percentile Output:												
fB%	2.3			2.5			2.2					
BOQ	10.2			7.4			12.5					
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		34	176	30		30	182	21
Peak-Hour Factor, PHF		0.85	0.85	0.85		0.91	0.91	0.91
Hourly Flow Rate, HFR		39	207	35		32	199	23
Percent Heavy Vehicles		8	--	--		18	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		28	18	23		22	16	36
Peak Hour Factor, PHF		0.88	0.88	0.88		0.78	0.78	0.78
Hourly Flow Rate, HFR		31	20	26		28	20	46
Percent Heavy Vehicles		10	10	10		1	1	1
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage		No			/	No		
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config	LTR	LTR			LTR				LTR	
v (vph)	39	32			77				94	
C(m) (vph)	1312	1236			439				514	
v/c	0.03	0.03			0.18				0.18	
95% queue length	0.09	0.08			0.63				0.66	
Control Delay	7.8	8.0			14.9				13.6	
LOS	A	A			B				B	
Approach Delay					14.9				13.6	
Approach LOS					B				B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume	34	176	30	30	182	21
Peak-Hour Factor, PHF	0.85	0.85	0.85	0.91	0.91	0.91
Peak-15 Minute Volume	10	52	9	8	50	6
Hourly Flow Rate, HFR	39	207	35	32	199	23
Percent Heavy Vehicles	8	--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		

Minor Street Movements	7	8	9	10	11	12		
	L	T	R	L	T	R		
Volume	28	18	23	22	16	36		
Peak Hour Factor, PHF	0.88	0.88	0.88	0.78	0.78	0.78		
Peak-15 Minute Volume	8	5	7	7	5	12		
Hourly Flow Rate, HFR	31	20	26	28	20	46		
Percent Heavy Vehicles	10	10	10	1	1	1		
Percent Grade (%)		0			0			
Flared Approach: Exists?/Storage			No	/		No		/
RT Channelized?								
Lanes	0	1	0	0	1	0		
Configuration		LTR			LTR			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	207	199
Shared ln volume, major rt vehicles:	35	23
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	8	18	10	10	10	1	1	1
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2	4.3	7.2	6.6	6.3	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	8	18	10	10	10	1	1	1
t(f)	2.3	2.4	3.6	4.1	3.4	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	222	242	610	588	224	600	594	210
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x) s P(x) V(c,u,x)		1500		1500		1500		1500
C(r,x) C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows		224		210
Potential Capacity		796		833
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		796		833
Probability of Queue free St.		0.97		0.94
Step 2: LT from Major St.		4		1
Conflicting Flows		242		222
Potential Capacity		1236		1312
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		1236		1312
Probability of Queue free St.		0.97		0.97
Maj L-Shared Prob Q free St.		0.97		0.97
Step 3: TH from Minor St.		8		11
Conflicting Flows		588		594
Potential Capacity		411		419
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		0.94		0.94
Movement Capacity		385		392
Probability of Queue free St.		0.95		0.95
Step 4: LT from Minor St.		7		10
Conflicting Flows		610		600
Potential Capacity		395		414
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor		0.89		0.89
Maj. L, Min T Adj. Imp Factor.		0.91		0.91
Cap. Adj. factor due to Impeding mvmnt		0.86		0.88
Movement Capacity		341		366

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	588	594
Potential Capacity	411	419
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity	385	392

Result for 2 stage process:

a		
y		
C t	385	392
Probability of Queue free St.	0.95	0.95

Step 4: LT from Minor St.	7	10
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Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	610	600
Potential Capacity	395	414
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.89	0.89
Maj. L, Min T Adj. Imp Factor.	0.91	0.91
Cap. Adj. factor due to Impeding mvmnt	0.86	0.88
Movement Capacity	341	366

Results for Two-stage process:

a		
y		
C t	341	366

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	31	20	26	28	20	46
Movement Capacity (vph)	341	385	796	366	392	833
Shared Lane Capacity (vph)		439			514	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	341	385	796	366	392	833
Volume	31	20	26	28	20	46
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		439			514	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	39	32		77			94	
C(m) (vph)	1312	1236		439			514	
v/c	0.03	0.03		0.18			0.18	
95% queue length	0.09	0.08		0.63			0.66	
Control Delay	7.8	8.0		14.9			13.6	
LOS	A	A		B			B	
Approach Delay				14.9			13.6	
Approach LOS				B			B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.97	0.97
v(i1), Volume for stream 2 or 5	207	199
v(i2), Volume for stream 3 or 6	35	23
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.97	0.97
d(M,LT), Delay for stream 1 or 4	7.8	8.0
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.3	0.2

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			226	17		18	228	
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91	
Hourly Flow Rate, HFR			265	19		19	250	
Percent Heavy Vehicles			--	--		15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		41		14				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		43		14				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			19			57					
C(m) (vph)			1207			533					
v/c			0.02			0.11					
95% queue length			0.05			0.36					
Control Delay			8.0			12.6					
LOS			A			B					
Approach Delay						12.6					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		226	17	18	228	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		66	5	5	63	
Hourly Flow Rate, HFR		265	19	19	250	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	41		14			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	11		4			
Hourly Flow Rate, HFR	43		14			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		250
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		284	562		274			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	274	
Potential Capacity	770	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	770	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	284	
Potential Capacity	1207	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1207	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	562	
Potential Capacity	492	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.98	0.97
Movement Capacity	484	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 562
Potential Capacity 492
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.98 0.97
Movement Capacity 484

Results for Two-stage process:
a
y
C t 484

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	43		14			
Movement Capacity (vph)	484		770			
Shared Lane Capacity (vph)		533				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	484		770			
Volume	43		14			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		533				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		19		57				
C(m) (vph)		1207		533				
v/c		0.02		0.11				
95% queue length		0.05		0.36				
Control Delay		8.0		12.6				
LOS		A		B				
Approach Delay				12.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		250
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	16	6	172	22	338	1	124	214	113	155	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	713	1712	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	527	1266	0.41	0.42	14.4	B	19.4	B
R	518	1244	0.73	0.42	22.3	C		

Northbound

LTR	709	1701	0.52	0.42	15.6	B	15.6	B
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Southbound

LTR	575	1379	0.54	0.42	16.8	B	16.8	B
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 17.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	16	6	172	22	338	1	124	214	113	155	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	48	6	94	1	34	58	33	45	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		27			215	376		369			312	
%InSharedLn												
Prop LTs		0.037			0.888			0.003			0.420	
Prop RTs		0.259			0.000	1.000		0.631			0.003	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	16	6	172	22	338	1	124	214	113	155	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	19	7	191	24	376	1	135	233	131	180	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	27			215 376			369			312		
Prop LTs	0.037			0.888			0.003			0.420		
Prop RTs	0.259			0.000 1.000			0.631			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.965			1.000 0.850			0.915			1.000		
fLT	0.994			0.730			0.999			0.697		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1712			1266 1244			1701			1379		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	27	1712	0.02	0.42	713	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	215	1266	0.17	0.42	527	0.41
Right	R	376	1244	# 0.30	0.42	518	0.73
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	369	1701	0.22	0.42	709	0.52
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	312	1379	# 0.23	0.42	575	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.42	10.4	1.000	713	0.50	0.1	0.0	10.5	B	10.5	B	
Westbound													
LT	0.41	0.42	12.3	1.000	527	0.50	2.1	0.0	14.4	B	19.4	B	
R	0.73	0.42	14.6	1.000	518	0.50	7.7	0.0	22.3	C			
Northbound													
LTR	0.52	0.42	13.0	1.000	709	0.50	2.5	0.0	15.6	B	15.6	B	
Southbound													
LTR	0.54	0.42	13.2	1.000	575	0.50	3.6	0.0	16.8	B	16.8	B	

Intersection delay = 17.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	191	1	131
Proportion of LT in LT lane group, PLT	0.037	0.888	0.003	0.420
Proportion of LT in opposing flow, PLTo	0.89	0.04	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	215	27	312	369
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	3.18	0.02	2.18
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.58	0.45	5.20	6.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	2.38	0.00	4.80	6.14
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	18.86
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	2.50
PTHo=1-PLTo	0.11	0.96	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.89	0.00	0.42
EL1 (refer to Exhibit C16-3)	1.72	1.42	1.90	2.02
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	2.50
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00	5.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.73	1.00	0.70
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.994	0.730	0.999	0.697

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	2.38		4.80	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.095		0.192	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	215		312	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.037		0.003	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	12.3	0.00	0.0	0.0	14.4
R	0.0	0.00	17.5	14.6	0.00	0.0	0.0	22.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.0	0.00	0.0	0.0	15.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.2	0.00	0.0	0.0	16.8
	0.0						0.0	
Intersection Delay			17.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	27			215	376	369		312	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1712			1266	1244	1701		1379	
LnCapacity	713			527	518	709		575	
Flow Ratio	0.0			0.2	0.3	0.2		0.2	
v/c Ratio	0.04			0.41	0.73	0.52		0.54	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.887		0.931		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.3			2.5	5.2	4.6		3.9	
kB	0.7			0.5	0.5	0.6		0.6	
Q2	0.0			0.3	1.2	0.7		0.7	
Q Average	0.3			2.9	6.4	5.3		4.6	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.3	1.2	1.2		1.2	
BOQ	0.4			3.6	7.9	6.5		5.7	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.6	1.5	1.5		1.5	
BOQ	0.5			4.5	9.5	7.9		7.0	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.8	1.6	1.7		1.7	
BOQ	0.6			5.1	10.5	8.8		7.8	
QSRatio									
95th Percentile Output:									
fB%	2.5			2.2	1.9	1.9		2.0	
BOQ	0.7			6.2	12.1	10.2		9.2	
QSRatio									
98th Percentile Output:									
fB%	3.1			2.5	2.1	2.2		2.3	
BOQ	0.9			7.3	13.6	11.7		10.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: No Bridge St & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				325		3		336			333	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.58 0.33 19.7 B 19.7 B

Northbound

T 970 1940 0.38 0.50 10.2 B 10.2 B

Southbound

T 946 1892 0.41 0.50 10.2 B 10.2 B

Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				325		3	336			333		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				92		1	91			97		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					372		365			387		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				325		3	336			333		
PHF				0.88		0.88	0.92			0.86		
Adj flow				369		3	365			387		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					372			365			387	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
fLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	372	1933	# 0.19	0.33	644	0.58
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	365	1940	0.19	0.50	970	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	387	1892	# 0.20	0.50	946	0.41
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
----------------------	---------------	------------------	---------------------	--------------------	----------------------------	------------------	------------------	-------------------------	--	-----------------------	--

Eastbound

Westbound

LR	0.58	0.33	16.5	1.000	644	0.50	3.2	0.0	19.7	B	19.7	B
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Northbound

T	0.38	0.50	9.2	1.000	970	0.50	1.0	0.0	10.2	B	10.2	B
---	------	------	-----	-------	-----	------	-----	-----	------	---	------	---

Southbound

T	0.41	0.50	9.4	1.000	946	0.50	0.7	0.0	10.2	B	10.2	B
---	------	------	-----	-------	-----	------	-----	-----	------	---	------	---

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.5	0.00	0.0	0.0	19.7
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.2	0.00	0.0	0.0	10.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.4	0.00	0.0	0.0	10.2
	0.0						0.0	
Intersection Delay			13.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		336	213	131	527	
Peak-Hour Factor, PHF		0.92	0.92	0.86	0.86	
Peak-15 Minute Volume		91	58	38	153	
Hourly Flow Rate, HFR		365	231	152	612	
Percent Heavy Vehicles		--	--	16	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		612
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		596						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	596	
Potential Capacity	915	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	915	
Probability of Queue free St.	0.83	1.00
Maj L-Shared Prob Q free St.	0.74	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.74	0.74
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.83	0.83
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.74 0.74
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.83 0.83
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R

Volume (vph)
Movement Capacity (vph)
Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		152						
C(m) (vph)		915						
v/c		0.17						
95% queue length		0.59						
Control Delay		9.7						
LOS		A						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.83
v(i1), Volume for stream 2 or 5		612
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.74
d(M,LT), Delay for stream 1 or 4		9.7
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.5

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/28/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				84		157		392	62	134	393	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 386 1447 0.72 0.27 30.3 C 30.3 C

Northbound

TR 1059 1869 0.47 0.57 8.9 A 8.9 A

Southbound

LT 771 1361 0.80 0.57 14.6 B 14.6 B

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/28/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				84		157	392	62		134	393	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				24		45	107	17		39	114	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					277			493			613	
%InSharedLn												
Prop LTs					0.350			0.000			0.254	
Prop RTs					0.650			0.136			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left Thru Right Peds					NB Left Thru Right Peds	P P X		
WB Left Thru Right Peds	P P X				SB Left Thru Right Peds	P P		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				84		157	392	62		134	393	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				97		180	426	67		156	457	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					277			493			613	
Prop LTs					0.350			0.000			0.254	
Prop RTs					0.650			0.136			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.912			0.982			1.000	
fLT					0.983			1.000			0.701	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1447			1869			1361	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	277	1447	# 0.19	0.27	386	0.72
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	493	1869	0.26	0.57	1059	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	613	1361	# 0.45	0.57	771	0.80
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.72	0.27	20.0	1.000	386	0.50	10.3	0.0	30.3	C	30.3	C
----	------	------	------	-------	-----	------	------	-----	------	---	------	---

Northbound

TR	0.47	0.57	7.7	1.000	1059	0.50	1.3	0.0	8.9	A	8.9	A
----	------	------	-----	-------	------	------	-----	-----	-----	---	-----	---

Southbound

LT	0.80	0.57	10.3	1.000	771	0.50	4.3	0.0	14.6	B	14.6	B
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Intersection delay = 15.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			156
Proportion of LT in LT lane group, PLT	0.350	0.000	0.254
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			493
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.60
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.22
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			2.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			5.13
gu=g-gq if gq>=gf, or = g-gf if gq<gf			28.87
n=Max(gq-gf)/2,0)			1.52
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.25
EL1 (refer to Exhibit C16-3)			2.28
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.70
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.701

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.13
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.151
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				493
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.254
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.650	0.136
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.0	0.00	0.0	0.0	30.3
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.7	0.00	0.0	0.0	8.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	10.3	0.00	0.0	0.0	14.6
	0.0						0.0	
Intersection Delay			15.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Richmond Valley Rd & Page Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	91	41	64	35	115	33	73	523	126	85	415	53
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	521	1514	0.44	0.34	24.5	C	24.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	548	1590	0.36	0.34	24.0	C	24.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	370	679	0.22	0.54	11.6	B		
TR	1050	1929	0.68	0.54	17.4	B	16.8	B

Southbound

LTR	1037	1904	0.58	0.54	16.0	B	16.0	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	91	41	64	35	115	33	73	523	126	85	415	53
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	26	12	19	10	31	9	20	144	35	24	117	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		228			199		80	713			606	
%InSharedLn												
Prop LTs		0.465			0.191		1.000	0.000			0.158	
Prop RTs		0.325			0.181			0.194			0.073	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	91	41	64	35	115	33	73	523	126	85	415	53
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	106	48	74	38	125	36	80	575	138	96	466	44
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	228			199			80 713			606		
Prop LTs	0.465			0.191			1.000 0.000			0.158		
Prop RTs	0.325			0.181			0.194			0.073		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.956			0.976			0.971			0.989		
fLT	0.757			0.909			0.390 1.000			0.633		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1514			1590			679 1929			1904		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	228	1514	# 0.15	0.34	521	0.44
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	199	1590	0.13	0.34	548	0.36
Right							
Northbound							
Prot							
Perm							
Left	L	80	679	0.12	0.54	370	0.22
Prot							
Perm							
Thru	TR	713	1929	# 0.37	0.54	1050	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	606	1904	0.32	0.54	1037	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.44	0.34	22.8	1.000	521	0.50	1.7	0.0	24.5	C	24.5	C
Westbound												
LTR	0.36	0.34	22.1	1.000	548	0.50	1.9	0.0	24.0	C	24.0	C
Northbound												
L	0.22	0.54	10.6	1.000	370	0.50	1.0	0.0	11.6	B		
TR	0.68	0.54	14.8	1.000	1050	0.50	2.6	0.0	17.4	B	16.8	B
Southbound												
LTR	0.58	0.54	13.7	1.000	1037	0.50	2.3	0.0	16.0	B	16.0	B

Intersection delay = 18.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			80	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.16	
Adjusted opposing flow rate, Vo (veh/h)			606	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.96	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			3.81	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			45.19	
n=Max(gq-gf)/2,0)			1.90	
PTHo=1-PLTo			0.84	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.36	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.77	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			3.81	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.39	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.390	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	106	38	96
Proportion of LT in LT lane group, PLT	0.465	0.191	0.000
Proportion of LT in opposing flow, PLTo	0.19	0.46	0.00
Adjusted opposing flow rate, Vo (veh/h)	199	228	713
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.65	0.95	2.40
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.97	5.70	17.83
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.3	8.5	4.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	5.72	6.90	21.89
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.28	22.52	27.11
n=Max(gq-gf)/2,0)	2.19	0.00	8.75
PTHo=1-PLTo	0.81	0.54	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.46	0.19	0.58
EL1 (refer to Exhibit C16-3)	1.70	1.75	2.83
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.95	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.08	0.06
gdifff=max(gq-gf,0)	4.39	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.76	0.91	0.36
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.757	0.909	0.633

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	5.72	6.90	3.81	21.89
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.185	0.222	0.078	0.447
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	199	228	606	713
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.465	0.191	1.000	0.158
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.325	0.181	0.194	0.073
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.8	0.00	0.0	0.0	24.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.1	0.00	0.0	0.0	24.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.6	0.00	0.0	0.0	11.6
TR	0.0	0.00	20.5	14.8	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	13.7	0.00	0.0	0.0	16.0
	0.0						0.0	
Intersection Delay			18.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	228		199		80	713	318	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1514		1590		679	1929	999	
LnCapacity	521		548		370	1050	544	
Flow Ratio	0.2		0.1		0.1	0.4	0.3	
v/c Ratio	0.44		0.36		0.22	0.68	0.58	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.4		3.7		1.0	12.9	5.3	
kB	0.5		0.7		0.4	0.9	0.7	
Q2	0.4		0.4		0.1	1.8	1.0	
Q Average	4.8		4.2		1.1	14.6	6.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	5.9		5.2		1.5	17.6	7.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	7.2		6.4		1.9	20.7	9.4	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.6	
BOQ	8.1		7.1		2.2	22.4	10.3	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.0		2.4	1.7	1.9	
BOQ	9.5		8.5		2.7	24.2	11.9	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.4		2.9	1.8	2.1	
BOQ	10.9		9.8		3.3	26.1	13.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 12-1 PM MD Peak Period
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	260						647			469		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	662	1986	0.45	0.33	25.7	C	25.7	C

Westbound

Northbound

T	2134	3842	0.33	0.56	11.2	B	11.2	B
---	------	------	------	------	------	---	------	---

Southbound

T	1951	3512	0.27	0.56	10.8	B	10.8	B
---	------	------	------	------	------	---	------	---

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	260						647			469		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	74						178			132		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	295						711			527		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	260						647			469		
PHF	0.88						0.91			0.89		
Adj flow	295						711			527		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	295						711			527		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.971							0.980				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	1986							3842				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	295	1986	# 0.15	0.33	662	0.45
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	711	3842	# 0.19	0.56	2134	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	527	3512	0.15	0.56	1951	0.27
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.33$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.38$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.45	0.33	23.5	1.000	662	0.50	2.2	0.0	25.7	C	25.7	C	
Westbound													
Northbound													
T	0.33	0.56	10.9	1.000	2134	0.50	0.3	0.0	11.2	B	11.2	B	
Southbound													
T	0.27	0.56	10.5	1.000	1951	0.50	0.3	0.0	10.8	B	10.8	B	

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.5	0.00	0.0	0.0	25.7
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.9	0.00	0.0	0.0	11.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.5	0.00	0.0	0.0	10.8
	0.0						0.0	
Intersection Delay			13.8	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	295						373		276	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.1						0.2		0.1	
v/c Ratio	0.45						0.33		0.27	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	5.8						5.1		3.6	
kB	0.9						0.9		1.1	
Q2	0.7						0.5		0.4	
Q Average	6.5						5.5		4.0	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	7.9						6.8		5.0	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	9.6						8.3		6.2	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.7		1.7	
BOQ	10.6						9.2		6.9	
QSRatio										
95th Percentile Output:										
fB%	1.9						1.9		2.0	
BOQ	12.1						10.7		8.2	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.2		2.4	
BOQ	13.6						12.2		9.5	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 469
 Peak-Hour Factor, PHF 0.89
 Peak-15 Minute Volume 132
 Hourly Flow Rate, HFR 526
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 84
 Peak Hour Factor, PHF 0.84
 Peak-15 Minute Volume 25
 Hourly Flow Rate, HFR 100
 Percent Heavy Vehicles 29
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
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Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								263
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		263
Potential Capacity		715
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		715
Probability of Queue free St.	1.00	0.86
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.86	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	532
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	532
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	532	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	532	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	597
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	597

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	786	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	1.00
Movement Capacity	676	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.86	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						100
Movement Capacity (vph)						715
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						715
Volume						100
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								100
C(m) (vph)								715
v/c								0.14
95% queue length								0.48
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Mohr St/KWVP
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	87	131	125	175	438	52	57	112	260	45	38	37
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	221	664	0.47	0.33	29.8	C		
TR	588	1764	0.45	0.33	25.7	C	26.9	C
Westbound								
L	271	814	0.72	0.33	40.3	D		
TR	1124	3371	0.47	0.33	25.0	C	29.1	C
Northbound								
LTR	887	3193	0.52	0.28	29.6	C	29.6	C
Southbound								
L	380	1711	0.15	0.22	28.9	C		
TR	358	1610	0.26	0.22	30.6	C	30.0	C

Intersection Delay = 28.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	87	131	125	175	438	52	57	112	260	45	38	37
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	26	39	37	49	122	14	15	30	70	14	12	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	104	267		194	530			461		56	93	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.132			0.000	
Prop RTs		0.416			0.081			0.607			0.495	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	87	131	125	175	438	52	57	112	260	45	38	37
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	104	156	111	194	487	43	61	120	280	56	47	46
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	104	267		194	530			461		56	93	
Prop LTs	1.000	0.000		1.000	0.000			0.132			0.000	
Prop RTs		0.416			0.081			0.607			0.495	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.943	0.943		0.962			0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.938			0.988		0.909				0.926	
fLT	0.365	1.000		0.487	1.000		0.993			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	664	1764		814	3371		3193			1711	1610	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	104	664	0.16	0.33	221	0.47
Prot							
Perm							
Thru	TR	267	1764	0.15	0.33	588	0.45
Right							
Westbound							
Prot							
Perm							
Left	L	194	814	# 0.24	0.33	271	0.72
Prot							
Perm							
Thru	TR	530	3371	0.16	0.33	1124	0.47
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	461	3193	# 0.14	0.28	887	0.52
Right							
Southbound							
Prot							
Perm							
Left	L	56	1711	0.03	0.22	380	0.15
Prot							
Perm							
Thru	TR	93	1610	# 0.06	0.22	358	0.26
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.44$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.53$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.47	0.33	23.7	1.000	221	0.50	6.0	0.0	29.8	C		
TR	0.45	0.33	23.6	1.000	588	0.50	2.2	0.0	25.7	C	26.9	C
Westbound												
L	0.72	0.33	26.3	1.000	271	0.50	14.0	0.0	40.3	D		
TR	0.47	0.33	23.7	1.000	1124	0.50	1.3	0.0	25.0	C	29.1	C
Northbound												
LTR	0.52	0.28	27.4	1.000	887	0.50	2.2	0.0	29.6	C	29.6	C
Southbound												
L	0.15	0.22	28.1	1.000	380	0.50	0.8	0.0	28.9	C		
TR	0.26	0.22	28.9	1.000	358	0.50	1.7	0.0	30.6	C	30.0	C

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.132 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.98			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.199			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	530			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.081
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.7	0.00	0.0	0.0	29.8
TR	0.0	0.00	30.0	23.6	0.00	0.0	0.0	25.7
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	26.3	0.00	0.0	0.0	40.3
TR	0.0	0.00	30.0	23.7	0.00	0.0	0.0	25.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	27.4	0.00	0.0	0.0	29.6
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.1	0.00	0.0	0.0	28.9
TR	0.0	0.00	35.0	28.9	0.00	0.0	0.0	30.6
	0.0						0.0	
Intersection Delay			28.8	sec/veh	Intersection LOS C			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	104	267		194	278		242			56	93	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	664	1764		814	1770		1676			1711	1610	
LnCapacity	221	588		271	590		465			380	358	
Flow Ratio	0.2	0.2		0.2	0.2		0.1			0.0	0.1	
v/c Ratio	0.47	0.45		0.72	0.47		0.52			0.15	0.26	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.1	5.2		4.2	5.5		5.1			1.1	1.9	
kB	0.3	0.7		0.4	0.7		0.7			0.6	0.5	
Q2	0.3	0.6		1.0	0.6		0.7			0.1	0.2	
Q Average	2.4	5.8		5.2	6.1		5.8			1.2	2.1	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	3.0	7.1		6.4	7.5		7.2			1.6	2.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.5	1.5		1.5			1.6	1.6	
BOQ	3.7	8.7		7.9	9.1		8.7			2.0	3.4	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.7		1.7	1.6		1.7			1.9	1.8	
BOQ	4.3	9.6		8.7	10.1		9.6			2.3	3.9	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.9		2.0	1.9		1.9			2.4	2.3	
BOQ	5.2	11.1		10.2	11.6		11.1			2.9	4.8	
QSRatio												
98th Percentile Output:												
fB%	2.6	2.2		2.2	2.1		2.2			2.9	2.7	
BOQ	6.2	12.6		11.6	13.1		12.6			3.5	5.7	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						338		
Peak-Hour Factor, PHF						0.87		
Hourly Flow Rate, HFR						388		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		166						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		178						
Percent Heavy Vehicles		4						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			178						
C(m) (vph)			612						
v/c			0.29						
95% queue length			1.20						
Control Delay			13.3						
LOS			B						
Approach Delay				13.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					338	
Peak-Hour Factor, PHF					0.87	
Peak-15 Minute Volume					97	
Hourly Flow Rate, HFR					388	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	166					
Peak Hour Factor, PHF	0.93					
Peak-15 Minute Volume	45					
Hourly Flow Rate, HFR	178					
Percent Heavy Vehicles	4					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	388	
Potential Capacity	612	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	612	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 388
Potential Capacity 612
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 612

Results for Two-stage process:
a
y
C t 612

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	178					
Movement Capacity (vph)	612					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	612					
Volume	178					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			178					
C(m) (vph)			612					
v/c			0.29					
95% queue length			1.20					
Control Delay			13.3					
LOS			B					
Approach Delay				13.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Mohr Street & Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Mohr Street
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	82	30	121	86	0	34	0	38	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.88	0.88	0.90	0.90	0.78	0.78		
Flow Rate	46	80	181	47	43	48		
% Heavy Veh	42	42	4	4	3	3		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	46	80	181	47	43	48		
Left-Turn	0	0	134	0	43	0		
Right-Turn	0	34	0	0	0	48		
Prop. Left-Turns	0.0	0.0	0.7	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	46	80	181	47	43	48		
Service Time	3.3	3.0	3.0	2.6	3.0	2.2		
Utilization, x	0.07	0.12	0.27	0.06	0.06	0.06		
Dep. headway, hd	5.64	5.34	5.28	4.90	5.02	4.22		
Capacity	296	330	431	297	293	298		
Delay	8.77	8.76	9.87	7.94	8.33	7.47		
LOS	A	A	A	A	A	A		
Approach:								
Delay		8.76		9.47		7.88		
LOS		A		A		A		
Intersection Delay	8.94				Intersection LOS	A		

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Tyrellan Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	58	83	295	101	238	17	217	145	63	21	290	210
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 1188 2674 0.44 0.44 18.3 B 18.3 B

Westbound

LTR 1052 2368 0.38 0.44 17.6 B 17.6 B

Northbound

DefL 321 722 0.78 0.44 37.8 D
 TR 809 1820 0.30 0.44 16.9 B 27.6 C

Southbound

LTR 1159 2607 0.50 0.44 19.4 B 19.4 B

Intersection Delay = 20.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	58	83	295	101	238	17	217	145	63	21	290	210
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	17	25	88	28	66	5	62	42	18	6	81	58
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		519			395		249	239			578	
%InSharedLn												
Prop LTs		0.133			0.284		1.000	0.000			0.040	
Prop RTs		0.676			0.048			0.301			0.403	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	58	83	295	101	238	17	217	145	63	21	290	210
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	69	99	351	112	264	19	249	167	72	23	322	233
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	519			395			249 239			578		
Prop LTs	0.133			0.284			1.000 0.000			0.040		
Prop RTs	0.676			0.048			0.301			0.403		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.899			0.993			0.955			0.940		
fLT	0.839			0.679			0.379 1.000			0.937		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2674			2368			722 1820			2607		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	519	2674	# 0.19	0.44	1188	0.44
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	395	2368	0.17	0.44	1052	0.38
Right							
Northbound							
Prot							
Perm							
Left	DefL	249	722	# 0.34	0.44	321	0.78
Prot							
Perm							
Thru	TR	239	1820	0.13	0.44	809	0.30
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	578	2607	0.22	0.44	1159	0.50
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.44	0.44	17.2	1.000	1188	0.50	1.0	0.0	18.3	B	18.3	B
Westbound												
LTR	0.38	0.44	16.7	1.000	1052	0.50	1.0	0.0	17.6	B	17.6	B
Northbound												
DefL	0.78	0.44	21.2	1.000	321	0.50	16.6	0.0	37.8	D		
TR	0.30	0.44	16.0	1.000	809	0.50	0.9	0.0	16.9	B	27.6	C
Southbound												
LTR	0.50	0.44	17.8	1.000	1159	0.50	1.5	0.0	19.4	B	19.4	B

Intersection delay = 20.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			40.0	
Effective permitted green time for LT lane group, g(s)			40.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			249	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			578	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.23	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.59	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			5.14	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			34.86	
n=Max(gq-gf)/2,0)			2.57	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.30	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.49	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.10	
gdifff=max(gq-gf,0)			5.14	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.38	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.379	

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	40.0	40.0		40.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0		40.0
Opposing effective green time, go (s)	40.0	40.0		40.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	69	112	23
Proportion of LT in LT lane group, PLT	0.133	0.284	0.000
Proportion of LT in opposing flow, PLTo	0.28	0.13	0.00
Adjusted opposing flow rate, Vo (veh/h)	395	519	239
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.73	2.80	0.57
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.19	6.81	2.99
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	5.9	1.3	17.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	1.51	3.92	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.14	36.08	22.90
n=Max(gq-gf)/2,0)	0.00	1.30	0.00
PTHo=1-PLTo	0.72	0.87	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.34	0.84	0.09
EL1 (refer to Exhibit C16-3)	2.11	2.40	1.77
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.28	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.09	0.05
gdif=max(gq-gf,0)	0.00	2.60	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.77	0.45	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.839	0.679	0.937

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		40.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	1.51	3.92		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.038	0.098		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	395	519		239
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.133	0.284		0.040
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	40.0	40.0	40.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.676	0.048	0.301
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	17.2	0.00	0.0	0.0 0.0 0.0	18.3
Westbound								
LTR	0.0 0.0 0.0	0.00	25.0	16.7	0.00	0.0	0.0 0.0 0.0	17.6
Northbound								
DefL	0.0	0.00	25.0	21.2	0.00	0.0	0.0	37.8
TR	0.0 0.0	0.00	25.0	16.0	0.00	0.0	0.0 0.0	16.9
Southbound								
LTR	0.0 0.0 0.0	0.00	25.0	17.8	0.00	0.0	0.0 0.0 0.0	19.4
Intersection Delay			20.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR			LTR		DefL	TR			LTR	
Init Queue		0.0			0.0		0.0	0.0			0.0	
Flow Rate		272			207		249	239			303	
So		1900			1900		1900	1900			1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	2	0
SL		1404			1243		722	1820			1369	
LnCapacity		623			552		321	809			608	
Flow Ratio		0.2			0.2		0.3	0.1			0.2	
v/c Ratio		0.44			0.38		0.78	0.30			0.50	
Grn Ratio		0.44			0.44		0.44	0.44			0.44	
I Factor		0.889			0.932			1.000			1.000	
AT or PVG		3			3		3	3			3	
Pltn Ratio		1.00			1.00		1.00	1.00			1.00	
PF2		1.00			1.00		1.00	1.00			1.00	
Q1		4.7			3.5		5.3	3.8			5.4	
kB		0.7			0.7		0.5	1.0			0.8	
Q2		0.6			0.4		1.5	0.4			0.8	
Q Average		5.2			3.9		6.8	4.2			6.2	
Q Spacing		25.0			25.0		25.0	25.0			25.0	
Q Storage		0			0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2		1.2	1.2			1.2	
BOQ		6.5			4.8		8.3	5.3			7.6	
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5		1.5	1.5			1.5	
BOQ		7.9			5.9		10.0	6.5			9.2	
QSRatio												
90th Percentile Output:												
fB%		1.7			1.7		1.6	1.7			1.6	
BOQ		8.8			6.7		11.1	7.3			10.2	
QSRatio												
95th Percentile Output:												
fB%		2.0			2.1		1.9	2.0			1.9	
BOQ		10.2			8.0		12.6	8.6			11.7	
QSRatio												
98th Percentile Output:												
fB%		2.2			2.4		2.1	2.3			2.1	
BOQ		11.7			9.3		14.2	9.9			13.2	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS

Agency: Philip Habib & Associates

Date: 08/03/2010

Period: Weekday 12-1 PM MD Peak Period

Project ID: 1121A - Charleston

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2011 Existing Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	583	321	3	1	350	333	0	0	1	69	0	119
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			85			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	793	1711	0.81	0.71	23.3	C		
TR	1158	1628	0.31	0.71	5.3	A	16.9	B
Westbound								
LT	451	1843	0.86	0.24	43.5	D	40.9	D
R	383	1568	0.71	0.24	37.2	D		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.30	0.18	35.5	D		
LT	320	1801	0.00	0.18	30.4	C	17.1	B
R	952	1478	0.13	0.64	6.5	A		

Intersection Delay = 25.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 08/03/2010
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	583	321	3	1	350	333	0	0	1	69	0	119
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	160	88	1	1	96	91	0	0	1	18	0	31
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			85			0			0
Adj Flow	641	356			386	273		4		71	0	123
%InSharedLn										0		
Prop LTs	1.000	0.000			0.003			0.000		1.000	0.000	
Prop RTs		0.008			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0		0		0			0		0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	583	321	3	1	350	333	0	0	1	69	0	119
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	641	353	3	1	385	273	0	0	4	71	0	123
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	641	356			386	273		4		71	0	123
Prop LTs	1.000	0.000			0.003			0.000		1.000	0.000	
Prop RTs		0.008			0.000	1.000		1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.980	0.980		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.865				1.000	0.850
fLT	0.950	1.000		0.999			1.000			0.755	1.000	
Sec.	0.167											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1711	1628		1843	1568		1844			1313	1801	1478
Sec.	300											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		641	1711	# 0.37	0.411	703	0.91
Perm		0	300	0.00	0.300	90	0.00
Left	L	641			0.71	793	0.81
Prot							
Perm							
Thru	TR	356	1628	0.22	0.71	1158	0.31
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	386	1843	# 0.21	0.24	451	0.86
Right	R	273	1568	0.17	0.24	383	0.71
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	71	1313	# 0.05	0.18	233	0.30
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	123	1478	0.08	0.64	952	0.13

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.81	0.71	16.8	1.000	793	0.50	6.5	0.0	23.3	C			
TR	0.31	0.71	4.8	1.000	1158	0.50	0.5	0.0	5.3	A	16.9	B	
Westbound													
LT	0.86	0.24	32.5	1.000	451	0.50	11.1	0.0	43.5	D	40.9	D	
R	0.71	0.24	31.1	1.000	383	0.50	6.1	0.0	37.2	D			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.30	0.18	32.2	1.000	233	0.50	3.3	0.0	35.5	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	17.1	B	

R 0.13 0.64 6.2 1.000 952 0.50 0.3 0.0 6.5 A

Intersection delay = 25.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	641			71
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	386			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	16.02			1.78
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.65			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	18.56			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.44			16.00
n=Max(gq-gf)/2,0)	9.28			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.88			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	9.18			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	18.56			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.167			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.003	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	356	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.90	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		1.99	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdif=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		356		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.003		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.008
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	641			
v/c ratio from Capacity Worksheet, X	0.81			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	18.56			
Unopposed green interval, gu	8.44			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.18			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.27			
XPerm	2.14			
XProt	0.64			
Case	3			
Queue at beginning of green arrow, Qa	7.19			
Queue at beginning of unsaturated green, Qu	3.31			
Residual queue, Qr	2.56			
Uniform Delay, d1	16.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		16.8	0.00	0.0	0.0	23.3
TR	0.0	0.00	13.0	4.8	0.00	0.0	0.0	5.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	32.5	0.00	0.0	0.0	43.5
R	0.0	0.00	34.0	31.1	0.00	0.0	0.0	37.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.2	0.00	0.0	0.0	35.5
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.2	0.00	0.0	0.0	6.5
Intersection Delay			25.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	641	356		386	273	4		71	0	123
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1116	1628		1843	1568	1844		1313	1801	1478
LnCapacity	793	1158		451	383	328		233	320	952
Flow Ratio	0.6	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	0.81	0.31		0.86	0.71	0.01		0.30	0.00	0.13
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	6.9	3.3		9.2	6.2	0.1		1.5	0.0	1.2
kB	0.7	0.9		0.4	0.3	0.5		0.4	0.5	1.1
Q2	2.6	0.4		1.7	0.8	0.0		0.2	0.0	0.2
Q Average	9.6	3.7		11.0	7.0	0.1		1.7	0.0	1.4
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	11.6	4.6		13.3	8.6	0.1		2.2	0.0	1.7
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.5	1.7		1.6	1.7	1.6
BOQ	13.8	5.7		15.7	10.3	0.2		2.8	0.0	2.2
QSRatio										
90th Percentile Output:										
fB%	1.6	1.7		1.6	1.6	2.0		1.9	2.0	1.9
BOQ	15.1	6.4		17.1	11.4	0.2		3.2	0.0	2.6
QSRatio										
95th Percentile Output:										
fB%	1.7	2.1		1.7	1.8	2.6		2.3	2.6	2.4
BOQ	16.7	7.7		18.8	12.9	0.2		4.0	0.0	3.2
QSRatio										
98th Percentile Output:										
fB%	1.9	2.4		1.9	2.1	3.2		2.8	3.2	2.8
BOQ	18.4	8.9		20.5	14.5	0.3		4.8	0.0	3.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: AS	Inter.: Boscombe Ave & Tyrellan Ave
Agency: Philip Habib & Associates	Area Type: All other areas
Date: 8/03/2011	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2011 Existing Conditions
Project ID: 1121A - Charleston	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	356	35	0	2	60	66	4	3	0	60	6	620
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4		5	6	7	8
EB	Left	P					NB Left	P		
	Thru	P					NB Thru	P		
	Right	P					NB Right	P		
	Peds	X					NB Peds	X		
WB	Left	P					SB Left	P		
	Thru	P					SB Thru	P		
	Right	P					SB Right	P		
	Peds	X					SB Peds	X		
NB	Right					EB	Right			
SB	Right					WB	Right			
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	713	1425	0.55	0.50	18.4	B		
TR	1056	2111	0.04	0.50	11.5	B	17.8	B

LTR	1538	3075	0.08	0.50	11.8	B	11.8	B
-----	------	------	------	------	------	---	------	---

DefL	518	1333	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	542	1394	0.14	0.39	18.2	B	24.1	C
R	593	1524	0.58	0.39	25.4	C		

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	356	35	0	2	60	66	4	3	0	60	6	620	
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6	
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90	
PK 15 Vol	98	10	0	1	16	18	2	1	0	17	2	172	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900		1900	1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0	
RTOR Vol			0			17			0			310	
Adj Flow	391	38			122		7	5			74	344	
%InSharedLn													
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.905		
Prop RTs		0.000			0.443			0.000			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0		0	0			0	0	
%InProtPhase													
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	356	35	0	2	60	66	4	3	0	60	6	620
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	391	38	0	2	66	54	7	5	0	67	7	344
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	391	38			122		7	5			74	344
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.905	
Prop RTs		0.000			0.443			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.934				1.000		1.000	0.850	
fLT	0.675	1.000		0.954			0.709	1.000		0.778		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1425	2111		3075			1333	1881		1394	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot Perm Left	DefL	391	1425	# 0.27	0.50	713	0.55
Prot Perm Thru	TR	38	2111	0.02	0.50	1056	0.04
Westbound							
Prot Perm Left Prot Perm Thru	LTR	122	3075	0.04	0.50	1538	0.08
Northbound							
Prot Perm Left	DefL	7	1333	0.01	0.39	518	0.01
Prot Perm Thru	TR	5	1881	0.00	0.39	732	0.01
Southbound							
Prot Perm Left Prot Perm Thru	LT	74	1394	0.05	0.39	542	0.14
Right	R	344	1524	# 0.23	0.39	593	0.58

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.50$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.56$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.55	0.50	15.5	1.000	713	0.50	2.9	0.0	18.4	B		
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	17.8	B
Westbound												
LTR	0.08	0.50	11.7	1.000	1538	0.50	0.1	0.0	11.8	B	11.8	B
Northbound												
DefL	0.01	0.39	16.9	1.000	518	0.50	0.0	0.0	16.9	B		
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.14	0.39	17.7	1.000	542	0.50	0.5	0.0	18.2	B	24.1	C

R 0.58 0.39 21.7 1.000 593 0.50 3.7 0.0 25.4 C

Intersection delay = 19.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	391		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	122		74	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/3600	9.78		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.60		1.85	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.48		1.41	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.675		0.709	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gfgq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	67
Proportion of LT in LT lane group, PLT	0.000	0.016 0.000 0.905
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	38	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.68
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.47	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.24
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.43	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.778

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	122	38	74	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.016	1.000	0.905
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.443	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.5	0.00	0.0	0.0	18.4
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.7	0.00	0.0	0.0	11.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.7	0.00	0.0	0.0	18.2
R	0.0	0.00	27.5	21.7	0.00	0.0	0.0	25.4
Intersection Delay			19.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	391	38			64		7	5		74	344	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1425	2111			1615		1333	1881		1394	1524	
LnCapacity	713	1056			807		518	732		542	593	
Flow Ratio	0.3	0.0			0.0		0.0	0.0		0.1	0.2	
v/c Ratio	0.55	0.04			0.08		0.01	0.01		0.14	0.58	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	6.7	0.5			0.8		0.1	0.1		1.2	6.8	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	1.0	0.0			0.1		0.0	0.0		0.1	0.9	
Q Average	7.8	0.5			0.9		0.1	0.1		1.3	7.7	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	9.5	0.7			1.2		0.2	0.1		1.7	9.4	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.7			1.6		1.7	1.7		1.6	1.5	
BOQ	11.4	0.9			1.5		0.2	0.1		2.1	11.3	
QSRatio												
90th Percentile Output:												
fB%	1.6	2.0			1.9		2.0	2.0		1.9	1.6	
BOQ	12.5	1.0			1.8		0.2	0.2		2.4	12.4	
QSRatio												
95th Percentile Output:												
fB%	1.8	2.5			2.4		2.6	2.6		2.4	1.8	
BOQ	14.1	1.3			2.2		0.3	0.2		3.1	14.0	
QSRatio												
98th Percentile Output:												
fB%	2.0	3.1			2.9		3.2	3.2		2.9	2.0	
BOQ	15.7	1.6			2.7		0.4	0.3		3.7	15.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	136		23				4	163			333	335
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.29	0.32	16.7	B	16.5	B
R	465	1468	0.04	0.32	14.4	B		
Westbound								
Northbound								
LT	1665	3222	0.11	0.52	7.6	A	7.6	A
Southbound								
TR	1920	3717	0.43	0.52	9.5	A	9.5	A

Intersection Delay = 10.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	136		23				4	163		333	335	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	39		7				1	45		104	105	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	155		19					185			835	
%InSharedLn												
Prop LTs								0.022			0.000	
Prop RTs			1.000					0.000			0.502	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975						0.998			0.686	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	136		23				4	163		333	335	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	155		19				4	181		416	419	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	155		19					185			835	
Prop LTs								0.022			0.000	
Prop RTs			1.000					0.000			0.502	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.909	0.909			0.962	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.925		
fLT	0.950				0.942	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1696	1468			3222	3717		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	155	1696	# 0.09	0.32	537	0.29
Prot							
Perm							
Thru							
Right	R	19	1468	0.01	0.32	465	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	185	3222	0.06	0.52	1665	0.11
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	835	3717	# 0.22	0.52	1920	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.29	0.32	15.4	1.000	537	0.50	1.3	0.0	16.7	B	16.5	B	
R	0.04	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B			
Westbound													
Northbound													
LT	0.11	0.52	7.4	1.000	1665	0.50	0.1	0.0	7.6	A	7.6	A	
Southbound													
TR	0.43	0.52	9.0	1.000	1920	0.50	0.5	0.0	9.5	A	9.5	A	

Intersection delay = 10.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.022 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	835
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.31
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	4.34
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	3.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.942

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.34	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.140	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			835	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.022	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.502
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.4	0.00	0.0	0.0	16.7
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.4	0.00	0.0	0.0	7.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.0	0.00	0.0	0.0	9.5
	0.0						0.0	
Intersection Delay			10.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	155	19				97		438	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1696	1468				1692		1952	
LnCapacity	537	465				874		1008	
Flow Ratio	0.1	0.0				0.1		0.2	
v/c Ratio	0.29	0.04				0.11		0.43	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	1.9	0.2				0.8		4.5	
kB	0.5	0.5				0.8		0.6	
Q2	0.2	0.0				0.1		0.5	
Q Average	2.2	0.2				0.9		5.0	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.7	0.3				1.2		6.2	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.5	
BOQ	3.4	0.4				1.5		7.6	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.7	
BOQ	3.9	0.5				1.8		8.4	
QSRatio									
95th Percentile Output:									
fB%	2.2	2.6				2.4		2.0	
BOQ	4.9	0.6				2.3		9.8	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.1				2.9		2.3	
BOQ	5.8	0.8				2.7		11.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Englewood Ave @ Veterans Rd W
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Volume	1	0		523	1		1			21	145	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	612	1468	0.45	0.42	14.9	B		
LT	587	1408	0.47	0.42	15.3	B	15.1	B

Northbound

L	451	1082	0.00	0.42	10.2	B	10.2	B
---	-----	------	------	------	------	---	------	---

Southbound

LTR	2031	4874	0.10	0.42	10.8	B	10.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		523	1		1			21	145	0
% Heavy Veh	1	1		1	1		1			2	2	2
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol	1	0		138	1		1			7	45	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			276	276		1			207		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.998		1.000				0.126	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.989		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		523	1		1			21	145	0
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	4	0		551	1		1			26	181	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			276	276		1			207		
Prop LTs	0.000			1.000 0.998			1.000			0.126		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.616		0.994	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1468 1408		1082		4874	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	276	1468	0.19	0.42	612	0.45
Prot							
Perm							
Thru	LT	276	1408	# 0.20	0.42	587	0.47
Right							
Northbound							
Prot							
Perm							
Left	L	1	1082	0.00	0.42	451	0.00
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	207	4874	# 0.04	0.42	2031	0.10
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.24
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.29

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.45	0.42	12.6	1.000	612	0.50	2.4	0.0	14.9	B			
LT	0.47	0.42	12.7	1.000	587	0.50	2.6	0.0	15.3	B	15.1	B	
Northbound													
L	0.00	0.42	10.2	1.000	451	0.50	0.0	0.0	10.2	B	10.2	B	
Southbound													
LTR	0.10	0.42	10.7	1.000	2031	0.50	0.1	0.0	10.8	B	10.8	B	

Intersection delay = 13.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		276	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.13	
Adjusted opposing flow rate, Vo (veh/h)		4	207	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.60	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	1.27	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	25.00	
n=Max(gq-gf)/2,0)		0.00	0.00	
PTHo=1-PLTo		1.00	0.87	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	1.62	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.62	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.616	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	275		
Proportion of LT in LT lane group, PLT	0.000	0.998	0.126
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.58		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	4		276	276	1			75	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	0	3
SL	1881		1468	1408	1082			1789	
LnCapacity	784		612	587	451			745	
Flow Ratio	0.0		0.2	0.2	0.0			0.0	
v/c Ratio	0.01		0.45	0.47	0.00			0.10	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.989			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		3.3	3.3	0.0			0.8	
kB	0.7		0.6	0.6	0.5			0.7	
Q2	0.0		0.5	0.5	0.0			0.1	
Q Average	0.0		3.8	3.8	0.0			0.8	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.2	1.3			1.3	
BOQ	0.1		4.7	4.8	0.0			1.1	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.5	1.7			1.7	
BOQ	0.1		5.8	5.9	0.0			1.4	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.7	1.7	2.0			1.9	
BOQ	0.1		6.6	6.7	0.0			1.6	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.1	2.1	2.6			2.4	
BOQ	0.1		7.8	7.9	0.0			2.1	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.4	2.4	3.2			3.0	
BOQ	0.1		9.1	9.2	0.0			2.5	
QSRatio									

ERROR MESSAGES

No errors to report.

Vehicle Volumes and Adjustments

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			298			
Peak Hour Factor, PHF			0.90			
Hourly Flow Rate, HFR			331			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					331			
C(m) (vph)					1035			
v/c					0.32			
95% queue length					1.39			
Control Delay					10.1			
LOS					B			
Approach Delay				10.1				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 22
 Peak-Hour Factor, PHF 0.55
 Peak-15 Minute Volume 10
 Hourly Flow Rate, HFR 39
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 298
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 83
 Hourly Flow Rate, HFR 331
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					39			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	39	
Potential Capacity	1035	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1035	
Probability of Queue free St.	0.68	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.68
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.68
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			331			
Movement Capacity (vph)			1035			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1035			
Volume			331			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					331			
C(m) (vph)					1035			
v/c					0.32			
95% queue length					1.39			
Control Delay					10.1			
LOS					B			
Approach Delay				10.1				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Veterans Rd W
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	47	29	64	50	0	0	0	0	29	73	19
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT	TR
PHF	0.86		0.77				0.80	0.80
Flow Rate	87		147				80	69
% Heavy Veh	17		4				1	1
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	87		147				80	69
Left-Turn	0		83				36	0
Right-Turn	33		0				0	23
Prop. Left-Turns	0.0		0.6				0.4	0.0
Prop. Right-Turns	0.4		0.0				0.0	0.3
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	37	39	0	0	75	21	39	59	63	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	88		124		76		105	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	88		124		76	105		
Left-Turn	43		0		44	0		
Right-Turn	0		27		0	71		
Prop. Left-Turns	0.5		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.2		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.3	-0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	88		124		76	105		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.08		0.11		0.07	0.09		
hd, final value	4.71		4.34		4.53	4.01		
x, final value	0.12		0.15		0.10	0.12		
Move-up time, m		2.0		2.0		2.0		
Service Time	2.7		2.3		2.5	2.0		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	88		124		76	105		
Service Time	2.7		2.3		2.5	2.0		
Utilization, x	0.12		0.15		0.10	0.12		
Dep. headway, hd	4.71		4.34		4.53	4.01		
Capacity	338		374		326	355		
Delay	8.32		8.11		8.01	7.54		
LOS	A		A		A	A		
Approach:								
Delay		8.32		8.11		7.74		
LOS		A		A		A		
Intersection Delay	7.98							

Intersection LOS A

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/03/2011
 Period: Weekday 12-1 PM MD Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	120	95	105	2	36	5	488	36	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	546	1560	0.43	0.35	17.4	B	16.6	B
R	560	1599	0.10	0.35	13.5	B		

Westbound

LTR	531	1518	0.08	0.35	13.4	B	13.4	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2287	4731	0.24	0.48	9.3	A	9.3	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 12.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	120	95	105	2	36	5	488	36	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	33	26	29	1	9	2	126	9	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		236	58		45			542				
%InSharedLn												
Prop LTs		0.559			0.044			0.928				
Prop RTs		0.000	1.000		0.111			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	120	95	105	2	36	5	488	36	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	132	104	58	2	38	5	503	37	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		236	58		45			542				
Prop LTs		0.559			0.044			0.928				
Prop RTs		0.000	1.000		0.111			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.952			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.985			0.999	
fLT	0.802			0.990			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1560	1599		1518			4731	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	236	1560	# 0.15	0.35	546	0.43
Right	R	58	1599	0.04	0.35	560	0.10
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	45	1518	0.03	0.35	531	0.08
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	542	4731	# 0.11	0.48	2287	0.24
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
LT	0.43	0.35	14.9	1.000	546	0.50	2.5	0.0	17.4	B	16.6	B
R	0.10	0.35	13.2	1.000	560	0.50	0.4	0.0	13.5	B		
Westbound												
LTR	0.08	0.35	13.1	1.000	531	0.50	0.3	0.0	13.4	B	13.4	B
Northbound												
LTR	0.24	0.48	9.0	1.000	2287	0.50	0.2	0.0	9.3	A	9.3	A
Southbound												

Intersection delay = 12.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	132	2	
Proportion of LT in LT lane group, PLT	0.559	0.044	0.928
Proportion of LT in opposing flow, PLTo	0.04	0.56	
Adjusted opposing flow rate, Vo (veh/h)	45	236	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.20	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.75	3.93	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.1	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	3.89	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.88	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.96	0.44	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.56	0.04	
EL1 (refer to Exhibit C16-3)	1.44	1.76	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.80	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.802	0.990	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	3.89		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.185		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	45	236	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.559	0.044	0.928	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.111	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.9	0.00	0.0	0.0	17.4
R	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.0	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			12.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound		
LaneGroup	LT	R	LTR	LTR				
Init Queue	0.0	0.0	0.0	0.0				
Flow Rate	236	58	45	198				
So	1900	1900	1900	1900				
No.Lanes	0 1	1	0 1	0 3	0	0	0	0
SL	1560	1599	1518	1736				
LnCapacity	546	560	531	839				
Flow Ratio	0.2	0.0	0.0	0.1				
v/c Ratio	0.43	0.10	0.08	0.24				
Grn Ratio	0.35	0.35	0.35	0.48				
I Factor	0.999		0.999	0.980				
AT or PVG	3	3	3	3				
Pltn Ratio	1.00	1.00	1.00	1.00				
PF2	1.00	1.00	1.00	1.00				
Q1	3.0	0.7	0.5	1.9				
kB	0.6	0.6	0.6	0.7				
Q2	0.4	0.1	0.1	0.2				
Q Average	3.4	0.7	0.6	2.2				
Q Spacing	25.0	25.0	25.0	25.0				
Q Storage	0	0	0	0				
Q S Ratio								
70th Percentile Output:								
fB%	1.3	1.3	1.3	1.3				
BOQ	4.3	0.9	0.7	2.7				
QSRatio								
85th Percentile Output:								
fB%	1.6	1.7	1.7	1.6				
BOQ	5.3	1.2	0.9	3.4				
QSRatio								
90th Percentile Output:								
fB%	1.8	1.9	1.9	1.8				
BOQ	6.0	1.4	1.1	3.9				
QSRatio								
95th Percentile Output:								
fB%	2.1	2.5	2.5	2.2				
BOQ	7.2	1.8	1.4	4.8				
QSRatio								
98th Percentile Output:								
fB%	2.5	3.0	3.0	2.7				
BOQ	8.4	2.2	1.7	5.8				
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Englewood Av & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	60		37				13	260		306	30	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	458	1716	0.26	0.27	18.7	B	18.7	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1094	1930	0.29	0.57	7.4	A	7.4	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1172	2069	0.31	0.57	7.5	A	7.5	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 9.1 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60		37				13	260		306	30	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	19		11				4	75		84	8	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		120						314			369	
%InSharedLn												
Prop LTs		0.617						0.048			0.000	
Prop RTs		0.383						0.000			0.089	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60		37				13	260		306	30	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	74		46				15	299		336	33	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		120						314			369	
Prop LTs		0.617						0.048			0.000	
Prop RTs	0.383						0.000			0.089		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.948						1.000			0.988		
fLT	0.970						0.979			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1716						1930			2069		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	120	1716	# 0.07	0.27	458	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	314	1930	0.16	0.57	1094	0.29
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	369	2069	# 0.18	0.57	1172	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.25
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.30

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.26	0.27	17.3	1.000	458	0.50	1.4	0.0	18.7	B	18.7	B
Westbound												
Northbound												
LT	0.29	0.57	6.7	1.000	1094	0.50	0.6	0.0	7.4	A	7.4	A
Southbound												
TR	0.31	0.57	6.9	1.000	1172	0.50	0.7	0.0	7.5	A	7.5	A

Intersection delay = 9.1 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	15
Proportion of LT in LT lane group, PLT	0.617
Proportion of LT in opposing flow, PLTo	0.048 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	369
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.25
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.43
gq, (see Exhibit C16-4,5,6,7,8)	3.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.27
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.05
EL1 (refer to Exhibit C16-3)	2.02
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.979

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			3.12	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.092	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			369	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.048	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Conflicting bicycle volume, Vbic (bicycles/h)				0
Vpedg				0
OCCpedg				0.000
Effective green, g (s)				34.0
Vbicg				0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.089
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	17.3	0.00	0.0	0.0	18.7
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	6.7	0.00	0.0	0.0	7.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	6.9	0.00	0.0	0.0	7.5
	0.0						0.0	
Intersection Delay			9.1	sec/veh	Intersection LOS A			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	120						314			369		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1716						1930			2069		
LnCapacity	458						1094			1172		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.26						0.29			0.31		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.6						2.7			3.2		
kB	0.5						0.9			0.9		
Q2	0.2						0.4			0.4		
Q Average	1.7						3.1			3.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.3			1.2		
BOQ	2.2						3.8			4.6		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.6			1.5		
BOQ	2.8						4.8			5.7		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.8			1.7		
BOQ	3.2						5.4			6.4		
QSRatio												
95th Percentile Output:												
fB%	2.3						2.1			2.1		
BOQ	4.0						6.6			7.6		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.5			2.4		
BOQ	4.8						7.7			8.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Sharrotts Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	52		50				41	279		257	55	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 550 1650 0.21 0.33 15.2 B 15.2 B

Westbound

Northbound

LT 849 1698 0.43 0.50 11.0 B 11.0 B

Southbound

TR 1038 2076 0.32 0.50 9.7 A 9.7 A

Intersection Delay = 11.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52		50				41	279		257	55	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	15		15				12	80		71	15	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		118						368			327	
%InSharedLn												
Prop LTs		0.508						0.128			0.000	
Prop RTs		0.492						0.000			0.138	
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52		50				41	279		257	55	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	60		58				47	321		282	45	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		118						368			327	
Prop LTs		0.508						0.128			0.000	
Prop RTs		0.492						0.000			0.138	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.934						1.000			0.981		
fLT	0.975						0.927			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1650						1698			2076		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	118	1650	# 0.07	0.33	550	0.21
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	368	1698	# 0.22	0.50	849	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	327	2076	0.16	0.50	1038	0.32
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.29

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.35

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.21	0.33	14.4	1.000	550	0.50	0.9	0.0	15.2	B	15.2	B
Westbound												
Northbound												
LT	0.43	0.50	9.6	1.000	849	0.50	1.5	0.0	11.0	B	11.0	B
Southbound												
TR	0.32	0.50	8.9	1.000	1038	0.50	0.8	0.0	9.7	A	9.7	A

Intersection delay = 11.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		47	
Proportion of LT in LT lane group, PLT	0.508	0.128	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		327	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.78	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		5.45	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		3.62	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.65	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.13	
EL1 (refer to Exhibit C16-3)		1.93	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.08	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.93	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.927	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			3.62	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.121	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		327	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.508		0.128	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.492	0.138
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	14.4	0.00	0.0	0.0 0.0 0.0	15.2
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	9.6	0.00	0.0	0.0 0.0 0.0	11.0
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	8.9	0.00	0.0	0.0 0.0 0.0	9.7
Intersection Delay			11.1	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	118						368			327		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1650						1698			2076		
LnCapacity	550						849			1038		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.21						0.43			0.32		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.4						3.9			3.2		
kB	0.6						0.7			0.8		
Q2	0.2						0.5			0.4		
Q Average	1.6						4.4			3.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.0						5.5			4.5		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	2.5						6.8			5.6		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7		
BOQ	2.9						7.6			6.3		
QSRatio												
95th Percentile Output:												
fB%	2.3						2.0			2.1		
BOQ	3.6						8.9			7.5		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.3			2.4		
BOQ	4.4						10.3			8.8		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Vets Rd E & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	9		98	186	437	118	59	146		313		30
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.05	0.13	23.1	C	32.4	C
R	220	1652	0.58	0.13	33.3	C		
Westbound								
LTR	1340	4728	0.64	0.28	20.5	C	20.5	C
Northbound								
L	190	569	0.35	0.33	19.7	B		
T	593	1778	0.28	0.33	15.8	B	16.9	B
Southbound								
TR	690	2070	0.55	0.33	18.9	B	18.9	B

Intersection Delay = 20.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9		98	186	437	118	59	146		313	30	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		32	53	126	34	17	41		87	8	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	12		127		852		66	164			381	
%InSharedLn												
Prop LTs					0.251		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000		0.087		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9		98	186	437	118	59	146		313	30	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	12		127	214	502	136	66	164		348	33	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	12		127		852		66	164			381	
Prop LTs					0.251		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000			0.087	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.943	0.943	0.980	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.976			1.000	0.988	
fLT	0.950		0.988		0.317	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4728		569	1778	2070	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	12	1668	0.01	0.13	222	0.05
Prot							
Perm							
Thru							
Right	R	127	1652	# 0.08	0.13	220	0.58
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	852	4728	# 0.18	0.28	1340	0.64
Right							
Northbound							
Prot							
Perm							
Left	L	66	569	0.12	0.33	190	0.35
Prot							
Perm							
Thru	T	164	1778	0.09	0.33	593	0.28
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	381	2070	# 0.18	0.33	690	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.05	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	32.4	C	
R	0.58	0.13	24.4	1.000	220	0.50	8.9	0.0	33.3	C			
Westbound													
LTR	0.64	0.28	18.8	1.000	1340	0.50	1.7	0.0	20.5	C	20.5	C	
Northbound													
L	0.35	0.33	15.1	1.000	190	0.50	4.7	0.0	19.7	B	16.9	B	
T	0.28	0.33	14.7	1.000	593	0.50	1.1	0.0	15.8	B			
Southbound													
TR	0.55	0.33	16.3	1.000	690	0.50	2.6	0.0	18.9	B	18.9	B	

Intersection delay = 20.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			66	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			381	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.10	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.35	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			8.15	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.85	
n=Max(gq-gf)/2,0)			4.07	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.87	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.32	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.317	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.251 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 PTHo=1-PLTo
 $PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N-1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			8.15	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.407	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			381	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.160	0.087
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	24.4	0.00	0.0	0.0	33.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	18.8	0.00	0.0	0.0	20.5
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.1	0.00	0.0	0.0	19.7
T	0.0	0.00	20.0	14.7	0.00	0.0	0.0	15.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.3	0.00	0.0	0.0	18.9
	0.0						0.0	
Intersection Delay			20.6	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	12	127		312		66	164		381
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1735		569	1778		2070
LnCapacity	222	220		491		190	593		690
Flow Ratio	0.0	0.1		0.2		0.1	0.1		0.2
v/c Ratio	0.05	0.58		0.64		0.35	0.28		0.55
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	2.0		4.5		0.8	2.0		5.2
kB	0.2	0.2		0.4		0.3	0.6		0.5
Q2	0.0	0.3		0.6		0.1	0.2		0.7
Q Average	0.2	2.3		5.2		1.0	2.2		5.8
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.2	2.9		6.4		1.2	2.8		7.2
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.5
BOQ	0.3	3.7		7.8		1.6	3.5		8.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.7		1.9	1.8		1.7
BOQ	0.4	4.2		8.7		1.8	4.0		9.7
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		2.0		2.4	2.2		1.9
BOQ	0.5	5.2		10.1		2.3	5.0		11.2
QSRatio									
98th Percentile Output:									
fB%	3.1	2.6		2.2		2.9	2.7		2.2
BOQ	0.6	6.1		11.6		2.8	5.9		12.7
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: S Service Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	14	7				6	200	105	213	358	26
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 456 1608 0.09 0.28 16.2 B 16.2 B

Westbound

Northbound

LTR 919 1671 0.38 0.55 8.8 A 8.8 A

Southbound

L 579 1053 0.41 0.55 9.5 A
 TR 1016 1847 0.42 0.55 8.9 A 9.1 A

Intersection Delay = 9.3 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	14	7				6	200	105	213	358	26
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	56	29	59	99	7
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		41						350		237	427	
%InSharedLn												
Prop LTs		0.195						0.020		1.000	0.000	
Prop RTs		0.268						0.337			0.068	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	14	7				6	200	105	213	358	26
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	8	22	11				7	225	118	237	398	29
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	41						350			237	427	
Prop LTs	0.195						0.020			1.000	0.000	
Prop RTs	0.268						0.337			0.068		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.943			0.990	0.990	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.992			1.000	0.992	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.964							0.954				0.990	
fLT	0.990							0.993			0.560	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1608							1671			1053	1847	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1608	# 0.03	0.28	456	0.09
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	350	1671	0.21	0.55	919	0.38
Right							
Southbound							
Prot							
Perm							
Left	L	237	1053	0.23	0.55	579	0.41
Prot							
Perm							
Thru	TR	427	1847	# 0.23	0.55	1016	0.42
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.26
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.31

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.28	15.8	1.000	456	0.50	0.4	0.0	16.2	B	16.2	B
Westbound												
Northbound												
LTR	0.38	0.55	7.7	1.000	919	0.50	1.1	0.0	8.8	A	8.8	A
Southbound												
L	0.41	0.55	7.8	1.000	579	0.50	1.7	0.0	9.5	A		
TR	0.42	0.55	7.9	1.000	1016	0.50	1.0	0.0	8.9	A	9.1	A

Intersection delay = 9.3 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				237
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				350
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.95
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				5.83
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.88
n=Max(gq-gf)/2,0)				1.56
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.81
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.55
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.12
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.56
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.560

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		7	
Proportion of LT in LT lane group, PLT	0.195	0.020	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		427	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.12	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.12	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		4.45	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.14	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.993	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			4.45	3.12
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.135	0.095
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			427	350
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.020	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.268	0.337	0.068
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.8	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.7	0.00	0.0	0.0	8.8
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	7.8	0.00	0.0	0.0	9.5
TR	0.0	0.00	13.5	7.9	0.00	0.0	0.0	8.9
	0.0						0.0	
Intersection Delay			9.3	sec/veh	Intersection LOS		A	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		41						350			237	427
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1608						1671			1053	1847
LnCapacity		456						919			579	1016
Flow Ratio		0.0						0.2			0.2	0.2
v/c Ratio		0.09						0.38			0.41	0.42
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.932				0.785
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.5						3.3			2.3	4.2
kB		0.5						0.8			0.5	0.7
Q2		0.0						0.5			0.3	0.5
Q Average		0.6						3.8			2.6	4.7
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.3	1.2
BOQ		0.7						4.7			3.3	5.8
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.6	1.5
BOQ		0.9						5.8			4.1	7.1
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.8	1.7
BOQ		1.1						6.6			4.7	7.9
QSRatio												
95th Percentile Output:												
fB%		2.5						2.1			2.2	2.0
BOQ		1.4						7.8			5.7	9.3
QSRatio												
98th Percentile Output:												
fB%		3.0						2.4			2.6	2.3
BOQ		1.7						9.1			6.8	10.7
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Amboy Rd & Bloomingdale Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	5	7	16	247	24	98	20	208	159	84	263	18
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	627	1410	0.06	0.44	14.4	B	14.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	548	1233	0.54	0.44	21.3	C		
T	763	1717	0.04	0.44	14.2	B	19.5	B
R	563	1266	0.21	0.44	16.0	B		

Northbound

LTR	689	1551	0.63	0.44	22.2	C	22.2	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	644	1450	0.63	0.44	22.3	C	22.3	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 21.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	7	16	247	24	98	20	208	159	84	263	18
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	2	5	74	7	29	6	58	45	23	73	5
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		36		294	29	117		435			405	
%InSharedLn												
Prop LTs		0.167		1.000	0.000			0.051			0.230	
Prop RTs		0.583			0.000	1.000		0.411			0.049	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.830			0.650			0.650	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	7	16	247	24	98	20	208	159	84	263	18
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	9	21	294	29	117	22	234	179	93	292	20
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	36			294	29	117	435			405		
Prop LTs	0.167			1.000	0.000	0.000	0.051			0.230		
Prop RTs	0.583			0.000 1.000			0.411			0.049		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.935	0.935	0.935	0.943		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.921		1.000 0.850			0.944		0.993		
fLT	0.979		0.734	1.000		0.970		0.789		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.994		
fRpb	0.967		1.000 1.000			0.977		1.000		
S	1410		1233	1717	1266	1551		1450		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	36	1410	0.03	0.44	627	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	294	1233	# 0.24	0.44	548	0.54
Prot							
Perm							
Thru	T	29	1717	0.02	0.44	763	0.04
Right	R	117	1266	0.09	0.44	563	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	435	1551	# 0.28	0.44	689	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	405	1450	0.28	0.44	644	0.63
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.52$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.58$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	627	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.54	0.44	18.2	1.000	548	0.50	3.1	0.0	21.3	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	19.5	B
R	0.21	0.44	15.3	1.000	563	0.50	0.7	0.0	16.0	B		
Northbound												
LTR	0.63	0.44	19.3	1.000	689	0.50	2.9	0.0	22.2	C	22.2	C
Southbound												
LTR	0.63	0.44	19.3	1.000	644	0.50	3.0	0.0	22.3	C	22.3	C

Intersection delay = 21.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		294		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.17		
Adjusted opposing flow rate, Vo (veh/h)		36		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.35		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.90		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.83		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.734		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	6	22	93
Proportion of LT in LT lane group, PLT	0.167	0.000	0.051
Proportion of LT in opposing flow, PLTo	0.00	0.23	0.05
Adjusted opposing flow rate, Vo (veh/h)	29	405	435
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.15	0.55	2.33
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.73	10.13	10.88
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	17.2	4.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	10.46	11.33
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	22.84	28.67
n=Max(gq-gf)/2,0)	0.00	0.00	3.53
PTHo=1-PLTo	1.00	0.77	0.95
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.17	0.05	0.23
EL1 (refer to Exhibit C16-3)	1.42	2.09	2.16
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	3.31
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	7.06
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.79
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.979	0.970	0.789

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	10.46	11.33
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.262	0.283
OCCpedu	0.000	0.056	0.000	0.048
Opposing flow rate, Vo (veh/h)	29	36	405	435
OCCr	0.000	0.053	0.000	0.026
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.974
Proportion of left turns, PLT	0.167	1.000	0.051	0.230
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.994
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.583	1.000	0.411	0.049
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.967	1.000	0.977	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.4
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.2	0.00	0.0	0.0	21.3
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	19.3	0.00	0.0	0.0	22.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	19.3	0.00	0.0	0.0	22.3
	0.0						0.0	
Intersection Delay			21.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	36		294	29	117	435		405	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1410		1233	1717	1266	1551		1450	
LnCapacity	627		548	763	563	689		644	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.3	
v/c Ratio	0.06		0.54	0.04	0.21	0.63		0.63	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.830			0.650		0.650	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.5		5.4	0.4	1.8	8.4		7.8	
kB	0.8		0.6	0.8	0.6	0.6		0.5	
Q2	0.1		0.7	0.0	0.2	1.0		0.9	
Q Average	0.6		6.1	0.4	2.0	9.3		8.7	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	0.7		7.5	0.6	2.5	11.4		10.6	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.5	
BOQ	0.9		9.0	0.7	3.1	13.5		12.6	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.6		1.6	
BOQ	1.1		10.0	0.9	3.6	14.7		13.8	
QSRatio									
95th Percentile Output:									
fB%	2.5		1.9	2.5	2.3	1.8		1.8	
BOQ	1.4		11.5	1.1	4.5	16.4		15.5	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.9		2.0	
BOQ	1.7		13.0	1.4	5.3	18.1		17.1	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/03/2011 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	125	175		16	141		178		26			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	910	1819	0.31	0.50	14.2	B	14.2	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	889	1778	0.19	0.50	12.9	B	12.9	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	577	1483	0.40	0.39	21.8	C	21.8	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 16.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		125	175	16	141		178		26			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		35	49	4	39		51		7			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		285			173			232				
%InSharedLn												
Prop LTs		0.000			0.104			0.871				
Prop RTs		0.512			0.000			0.129				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		125	175	16	141		178		26			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		139	146	18	155		202		30			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		285			173			232				
Prop LTs		0.000			0.104			0.871				
Prop RTs		0.512			0.000			0.129				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.931			1.000			0.983					
fLT	1.000			0.958			0.958					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1819			1778			1483					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.31	0.50	13.3	1.000	910	0.50	0.9	0.0	14.2	B	14.2	B
Westbound												
LT	0.19	0.50	12.5	1.000	889	0.50	0.5	0.0	12.9	B	12.9	B
Northbound												
LR	0.40	0.39	19.9	1.000	577	0.50	1.9	0.0	21.8	C	21.8	C
Southbound												

Intersection delay = 16.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	18		
Proportion of LT in LT lane group, PLT	0.000	0.104	0.871
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	285		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	0.45		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.13		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	5.58		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.26		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.10		
EL1 (refer to Exhibit C16-3)	1.85		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.958		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
TR	0.0						0.0	
	0.0	0.00	22.5	13.3	0.00	0.0	0.0	14.2
	0.0						0.0	
Westbound								
LT	0.0						0.0	
	0.0	0.00	22.5	12.5	0.00	0.0	0.0	12.9
	0.0						0.0	
Northbound								
LR	0.0						0.0	
	0.0	0.00	27.5	19.9	0.00	0.0	0.0	21.8
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			16.5	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		285			173			232				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1819			1778			1483				
LnCapacity		910			889			577				
Flow Ratio		0.2			0.1			0.2				
v/c Ratio		0.31			0.19			0.40				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		4.2			2.4			4.2				
kB		1.0			1.0			0.7				
Q2		0.5			0.3			0.5				
Q Average		4.7			2.6			4.7				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.3			1.2				
BOQ		5.8			3.3			5.8				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.6			1.5				
BOQ		7.1			4.2			7.1				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.8			1.7				
BOQ		8.0			4.7			7.9				
QSRatio												
95th Percentile Output:												
fB%		2.0			2.2			2.0				
BOQ		9.3			5.8			9.3				
QSRatio												
98th Percentile Output:												
fB%		2.3			2.6			2.3				
BOQ		10.7			6.8			10.7				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	 	4 L	5 T	6 R
Volume		27	181	60		54	178	26
Peak-Hour Factor, PHF		0.87	0.87	0.87		0.81	0.81	0.81
Hourly Flow Rate, HFR		31	208	68		66	219	32
Percent Heavy Vehicles		6	--	--		9	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	 	10 L	11 T	12 R
Volume		49	16	32		32	17	27
Peak Hour Factor, PHF		0.81	0.81	0.81		0.86	0.86	0.86
Hourly Flow Rate, HFR		60	19	39		37	19	31
Percent Heavy Vehicles		1	1	1		2	2	2
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage		No			/	No		
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		

Delay, Queue Length, and Level of Service

Approach	NB			SB			Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12				
Lane Config	LTR	LTR		LTR			LTR					
v (vph)	31	66		118			87					
C(m) (vph)	1291	1248		392			397					
v/c	0.02	0.05		0.30			0.22					
95% queue length	0.07	0.17		1.25			0.82					
Control Delay	7.9	8.0		18.1			16.6					
LOS	A	A		C			C					
Approach Delay				18.1			16.6					
Approach LOS				C			C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	27	181	60	54	178	26
Peak-Hour Factor, PHF	0.87	0.87	0.87	0.81	0.81	0.81
Peak-15 Minute Volume	8	52	17	17	55	8
Hourly Flow Rate, HFR	31	208	68	66	219	32
Percent Heavy Vehicles	6	--	--	9	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	49	16	32	32	17	27
Peak Hour Factor, PHF	0.81	0.81	0.81	0.86	0.86	0.86
Peak-15 Minute Volume	15	5	10	9	5	8
Hourly Flow Rate, HFR	60	19	39	37	19	31
Percent Heavy Vehicles	1	1	1	2	2	2
Percent Grade (%)	0				0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	208	219
Shared ln volume, major rt vehicles:	68	32
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	6	9	1	1	1	2	2	2
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.2	4.2	7.1	6.5	6.2	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	6	9	1	1	1	2	2	2
t(f)	2.3	2.3	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	251	276	696	687	242	700	705	235
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x) s P(x) V(c,u,x)		1500		1500		1500		1500
C(r,x) C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows		242		235
Potential Capacity		799		804
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		799		804
Probability of Queue free St.		0.95		0.96
Step 2: LT from Major St.		4		1
Conflicting Flows		276		251
Potential Capacity		1248		1291
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		1248		1291
Probability of Queue free St.		0.95		0.98
Maj L-Shared Prob Q free St.		0.94		0.97
Step 3: TH from Minor St.		8		11
Conflicting Flows		687		705
Potential Capacity		371		361
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		0.91		0.91
Movement Capacity		338		329
Probability of Queue free St.		0.94		0.94
Step 4: LT from Minor St.		7		10
Conflicting Flows		696		700
Potential Capacity		357		354
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor		0.86		0.86
Maj. L, Min T Adj. Imp Factor.		0.89		0.89
Cap. Adj. factor due to Impeding mvmnt		0.86		0.85
Movement Capacity		306		301

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	687	705
Potential Capacity	371	361
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	0.91
Movement Capacity	338	329

Result for 2 stage process:

a		
y		
C t	338	329
Probability of Queue free St.	0.94	0.94

Step 4: LT from Minor St.	7	10
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Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	696	700
Potential Capacity	357	354
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.86	0.86
Maj. L, Min T Adj. Imp Factor.	0.89	0.89
Cap. Adj. factor due to Impeding mvmnt	0.86	0.85
Movement Capacity	306	301

Results for Two-stage process:

a		
y		
C t	306	301

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	60	19	39	37	19	31
Movement Capacity (vph)	306	338	799	301	329	804
Shared Lane Capacity (vph)		392			397	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	306	338	799	301	329	804
Volume	60	19	39	37	19	31
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		392			397	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	31	66		118			87	
C(m) (vph)	1291	1248		392			397	
v/c	0.02	0.05		0.30			0.22	
95% queue length	0.07	0.17		1.25			0.82	
Control Delay	7.9	8.0		18.1			16.6	
LOS	A	A		C			C	
Approach Delay				18.1			16.6	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.98	0.95
v(i1), Volume for stream 2 or 5	208	219
v(i2), Volume for stream 3 or 6	68	32
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.97	0.94
d(M,LT), Delay for stream 1 or 4	7.9	8.0
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.2	0.5

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			243	17		13	241	
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81	
Hourly Flow Rate, HFR			279	19		16	297	
Percent Heavy Vehicles			--	--		7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		27		25				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		39		36				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			16			75					
C(m) (vph)			1235			545					
v/c			0.01			0.14					
95% queue length			0.04			0.47					
Control Delay			8.0			12.7					
LOS			A			B					
Approach Delay						12.7					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
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TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		243	17	13	241	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		70	5	4	74	
Hourly Flow Rate, HFR		279	19	16	297	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	27		25			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	10		9			
Hourly Flow Rate, HFR	39		36			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		297
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		298	617		288			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)	
s	1500
P(x)	
V(c,u,x)	

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	288	
Potential Capacity	739	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	739	
Probability of Queue free St.	0.95	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	298	
Potential Capacity	1235	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1235	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	617	
Potential Capacity	445	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.94
Movement Capacity	439	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity
Probability of Queue free St.

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 617
Potential Capacity 445
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.94
Movement Capacity 439

Results for Two-stage process:
a
y
C t 439

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	39		36			
Movement Capacity (vph)	439		739			
Shared Lane Capacity (vph)		545				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	439		739			
Volume	39		36			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		545				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		16		75				
C(m) (vph)		1235		545				
v/c		0.01		0.14				
95% queue length		0.04		0.47				
Control Delay		8.0		12.7				
LOS		A		B				
Approach Delay				12.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		297
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	10	2	211	19	218	4	122	262	160	217	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1743	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	535	1283	0.52	0.42	16.4	B	16.3	B
R	523	1256	0.51	0.42	16.2	B		

Northbound

LTR	742	1780	0.56	0.42	16.1	B	16.1	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	516	1239	0.85	0.42	31.9	C	31.9	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 21.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	10	2	211	19	218	4	122	262	160	217	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	64	6	66	1	33	70	47	63	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		14			280	266		417			439	
%InSharedLn												
Prop LTs		0.071			0.918			0.010			0.424	
Prop RTs		0.143			0.000	1.000		0.676			0.002	
Peds Bikes		0			0	0		0			0	0
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	10	2	211	19	218	4	122	262	160	217	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	11	2	257	23	266	4	131	282	186	252	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	14			280 266			417			439		
Prop LTs	0.071			0.918			0.010			0.424		
Prop RTs	0.143			0.000 1.000			0.676			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.981			1.000 0.850			0.909			1.000		
fLT	0.986			0.733			0.996			0.621		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1283 1256			1780			1239		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	14	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	280	1283	# 0.22	0.42	535	0.52
Right	R	266	1256	0.21	0.42	523	0.51
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	417	1780	0.23	0.42	742	0.56
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	439	1239	# 0.35	0.42	516	0.85
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.69

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.52	0.42	13.1	1.000	535	0.50	3.4	0.0	16.4	B	16.3	B
R	0.51	0.42	13.0	1.000	523	0.50	3.3	0.0	16.2	B		
Northbound												
LTR	0.56	0.42	13.3	1.000	742	0.50	2.8	0.0	16.1	B	16.1	B
Southbound												
LTR	0.85	0.42	15.8	1.000	516	0.50	16.1	0.0	31.9	C	31.9	C

Intersection delay = 21.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	257	4	186
Proportion of LT in LT lane group, PLT	0.071	0.918	0.010	0.424
Proportion of LT in opposing flow, PLTo	0.92	0.07	0.42	0.01
Adjusted opposing flow rate, Vo (veh/h)	280	14	439	417
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	4.28	0.07	3.10
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.67	0.23	7.32	6.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	4.02	0.00	7.71	7.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	17.78
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	3.61
PTHo=1-PLTo	0.08	0.93	0.58	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07	0.92	0.01	0.42
EL1 (refer to Exhibit C16-3)	1.84	1.40	2.16	2.12
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	3.57
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00	7.22
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.73	1.00	0.62
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.986	0.733	0.996	0.621

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	4.02		7.71	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.161		0.309	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	280		439	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.071		0.010	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.1	0.00	0.0	0.0	16.4
R	0.0	0.00	17.5	13.0	0.00	0.0	0.0	16.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.3	0.00	0.0	0.0	16.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.8	0.00	0.0	0.0	31.9
	0.0						0.0	
Intersection Delay			21.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	14			280	266	417			439			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1743			1283	1256	1780			1239			
LnCapacity	726			535	523	742			516			
Flow Ratio	0.0			0.2	0.2	0.2			0.4			
v/c Ratio	0.02			0.52	0.51	0.56			0.85			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.933		0.919			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			3.5	3.3	5.3			6.6			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			0.6	0.5	0.8			2.5			
Q Average	0.2			4.0	3.8	6.1			9.1			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			5.0	4.7	7.5			11.0			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.4			
BOQ	0.3			6.2	5.9	9.1			13.1			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.7	1.7	1.6			1.6			
BOQ	0.3			7.0	6.6	10.1			14.3			
QSRatio												
95th Percentile Output:												
fB%	2.6			2.0	2.1	1.9			1.8			
BOQ	0.4			8.3	7.9	11.6			16.0			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.4	2.4	2.1			1.9			
BOQ	0.5			9.6	9.1	13.1			17.6			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				483		4		384			430	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.87 0.33 24.6 C 24.6 C

Northbound

T 1026 2051 0.40 0.50 10.5 B 10.5 B

Southbound

T 954 1907 0.52 0.50 10.9 B 10.9 B

Intersection Delay = 16.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				483		4	384			430		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				144		1	103			125		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					580		413			500		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				483		4	384			430		
PHF				0.84		0.84	0.93			0.86		
Adj flow				575		5	413			500		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					580			413			500	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	580	2009	# 0.29	0.33	670	0.87
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	413	2051	0.20	0.50	1026	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	500	1907	# 0.26	0.50	954	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.87	0.33	18.7	1.000	670	0.50	5.9	0.0	24.6	C	24.6	C	
Northbound													
T	0.40	0.50	9.4	1.000	1026	0.50	1.1	0.0	10.5	B	10.5	B	
Southbound													
T	0.52	0.50	10.2	1.000	954	0.50	0.7	0.0	10.9	B	10.9	B	

Intersection delay = 16.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/C				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.7	0.00	0.0	0.0	24.6
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.2	0.00	0.0	0.0	10.9
	0.0						0.0	
Intersection Delay			16.1	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		384	232	175	738	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		103	62	51	215	
Hourly Flow Rate, HFR		412	249	203	858	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		858
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		661						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	661	
Potential Capacity	856	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	856	
Probability of Queue free St.	0.76	1.00
Maj L-Shared Prob Q free St.	0.52	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.52	0.52
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.52 0.52
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.76 0.76
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		203						
C(m) (vph)		856						
v/c		0.24						
95% queue length		0.92						
Control Delay		10.5						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.76
v(i1), Volume for stream 2 or 5		858
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.52
d(M,LT), Delay for stream 1 or 4		10.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		5.0

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				116		126	490	88		97	641	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 398 1494 0.72 0.27 29.9 C 29.9 C

Northbound

TR 1098 1937 0.57 0.57 10.0- A 10.0- A

Southbound

LT 870 1535 0.99 0.57 20.4 C 20.4 C

Intersection Delay = 18.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				116		126	490	88		97	641	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				35		38	132	24		28	186	
Hi Ln Vol												
% Grade				0			0			0		
Ideal Sat				1900			1900			1900		
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width				12.0			15.0			15.0		
RTOR Vol						0			0			
Adj Flow				288			622			858		
%InSharedLn												
Prop LTs					0.479			0.000			0.132	
Prop RTs					0.521			0.153			0.000	
Peds Bikes	0			0		0	0		0			
Buses				0			4			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				116		126	490	88		97	641	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				138		150	527	95		113	745	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					288			622			858	
Prop LTs					0.479			0.000			0.132	
Prop RTs					0.521			0.153			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.930			0.979			1.000	
fLT					0.977			1.000			0.785	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1494			1937			1535	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	288	1494	# 0.19	0.27	398	0.72
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	622	1937	0.32	0.57	1098	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	858	1535	# 0.56	0.57	870	0.99
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.75
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.90

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.72	0.27	20.0	1.000	398	0.50	9.9	0.0	29.9	C	29.9	C	
Northbound													
TR	0.57	0.57	8.3	1.000	1098	0.50	1.7	0.0	10.0-	A	10.0-	A	
Southbound													
LT	0.99	0.57	12.8	1.000	870	0.50	7.6	0.0	20.4	C	20.4	C	

Intersection delay = 18.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			113
Proportion of LT in LT lane group, PLT	0.479	0.000	0.132
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			622
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.88
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.37
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			4.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.09
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.91
n=Max(gq-gf)/2,0)			1.32
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.13
EL1 (refer to Exhibit C16-3)			2.59
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.785

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.09
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.209
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				622
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.132
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.521	0.153
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.0	0.00	0.0	0.0	29.9
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	12.8	0.00	0.0	0.0	20.4
	0.0						0.0	
Intersection Delay			18.3	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	61	30	94	32	155	32	50	512	100	96	488	37
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	555	1610	0.38	0.34	23.2	C	23.2	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	568	1649	0.48	0.34	26.0	C	26.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	327	600	0.17	0.54	11.1	B		
TR	1065	1957	0.63	0.54	16.5	B	16.0	B

Southbound

LTR	1085	1993	0.65	0.54	17.3	B	17.3	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	61	30	94	32	155	32	50	512	100	96	488	37
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
PK 15 Vol	17	9	27	10	48	10	14	141	27	28	140	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		210			271		55	673			702	
%InSharedLn												
Prop LTs		0.329			0.148		1.000	0.000			0.157	
Prop RTs		0.510			0.148			0.163			0.044	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	61	30	94	32	155	32	50	512	100	96	488	37
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
Adj flow	69	34	107	40	191	40	55	563	110	110	561	31
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	210			271			55 673			702		
Prop LTs	0.329			0.148			1.000 0.000			0.157		
Prop RTs	0.510			0.148			0.163			0.044		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.931			0.980			0.975			0.993		
fLT	0.811			0.929			0.342 1.000			0.635		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1610			1649			600 1957			1993		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	210	1610	0.13	0.34	555	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	271	1649	# 0.16	0.34	568	0.48
Right							
Northbound							
Prot							
Perm							
Left	L	55	600	0.09	0.54	327	0.17
Prot							
Perm							
Thru	TR	673	1957	0.34	0.54	1065	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	702	1993	# 0.35	0.54	1085	0.65
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.38	0.34	22.2	1.000	555	0.50	1.0	0.0	23.2	C	23.2	C	
Westbound													
LTR	0.48	0.34	23.1	1.000	568	0.50	2.9	0.0	26.0	C	26.0	C	
Northbound													
L	0.17	0.54	10.3	1.000	327	0.50	0.9	0.0	11.1	B			
TR	0.63	0.54	14.2	1.000	1065	0.50	2.2	0.0	16.5	B	16.0	B	
Southbound													
LTR	0.65	0.54	14.4	1.000	1085	0.50	2.9	0.0	17.3	B	17.3	B	

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			55	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.16	
Adjusted opposing flow rate, Vo (veh/h)			702	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.38	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.22	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			5.56	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			43.44	
n=Max(gq-gf)/2,0)			2.78	
PTHo=1-PLTo			0.84	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.60	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.41	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			5.56	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.34	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.342	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	69	40	110
Proportion of LT in LT lane group, PLT	0.329	0.148	0.000
Proportion of LT in opposing flow, PLTo	0.15	0.33	0.00
Adjusted opposing flow rate, Vo (veh/h)	271	210	673
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.73	1.00	2.75
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.78	5.25	16.83
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	4.2	8.1	2.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	8.57	6.17	19.48
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.43	22.88	29.52
n=Max(gq-gf)/2,0)	2.17	0.00	8.28
PTHo=1-PLTo	0.85	0.67	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.33	0.15	0.58
EL1 (refer to Exhibit C16-3)	1.83	1.72	2.72
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.99	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	4.34	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.93	0.36
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.811	0.929	0.635

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	8.57	6.17	5.56	19.48
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.276	0.199	0.113	0.398
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	271	210	702	673
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.329	0.148	1.000	0.157
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.510	0.148	0.163	0.044
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.2	0.00	0.0	0.0	23.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	23.1	0.00	0.0	0.0	26.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.3	0.00	0.0	0.0	11.1
TR	0.0	0.00	20.5	14.2	0.00	0.0	0.0	16.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	14.4	0.00	0.0	0.0	17.3
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	210		271		55	673	368	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1610		1649		600	1957	1046	
LnCapacity	555		568		327	1065	569	
Flow Ratio	0.1		0.2		0.1	0.3	0.4	
v/c Ratio	0.38		0.48		0.17	0.63	0.65	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.0		5.3		0.7	11.7	6.5	
kB	0.4		0.8		0.4	0.9	0.7	
Q2	0.2		0.7		0.1	1.5	1.3	
Q Average	4.2		6.0		0.8	13.2	7.8	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	5.2		7.4		1.0	16.0	9.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.7	1.4	1.5	
BOQ	6.4		8.9		1.3	18.8	11.3	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.6	
BOQ	7.2		9.9		1.5	20.3	12.5	
QSRatio								
95th Percentile Output:								
fB%	2.0		1.9		2.5	1.7	1.8	
BOQ	8.5		11.4		1.9	22.1	14.0	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.2		3.0	1.8	2.0	
BOQ	9.8		12.9		2.3	23.9	15.6	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	341							605			555	
Lane Width	16.0							14.5			12.0	
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	675	2025	0.56	0.33	27.8	C	27.8	C

Westbound

Northbound

T 2156 3880 0.31 0.56 11.0 B 11.0 B

Southbound

T 1990 3582 0.32 0.56 11.2 B 11.2 B

Intersection Delay = 14.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	341						605			555		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	94						168			159		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	375						672			638		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	341						605			555		
PHF	0.91						0.90			0.87		
Adj flow	375						672			638		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	375						672			638		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.990							0.990				0.990			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2025							3880				3582			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	375	2025	# 0.19	0.33	675	0.56
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	672	3880	0.17	0.56	2156	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	638	3582	# 0.18	0.56	1990	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.56	0.33	24.5	1.000	675	0.50	3.3	0.0	27.8	C	27.8	C	
Westbound													
Northbound													
T	0.31	0.56	10.8	1.000	2156	0.50	0.3	0.0	11.0	B	11.0	B	
Southbound													
T	0.32	0.56	10.8	1.000	1990	0.50	0.4	0.0	11.2	B	11.2	B	

Intersection delay = 14.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	375						352		335	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.56						0.31		0.32	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	7.7						4.7		4.5	
kB	0.9						1.0		1.1	
Q2	1.1						0.4		0.5	
Q Average	8.7						5.2		5.1	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	10.6						6.4		6.3	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	12.7						7.8		7.6	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.7		1.7	
BOQ	13.8						8.7		8.5	
QSRatio										
95th Percentile Output:										
fB%	1.8						2.0		2.0	
BOQ	15.5						10.1		9.9	
QSRatio										
98th Percentile Output:										
fB%	2.0						2.2		2.2	
BOQ	17.1						11.5		11.4	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 555
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 159
 Hourly Flow Rate, HFR 637
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 66
 Peak Hour Factor, PHF 0.78
 Peak-15 Minute Volume 21
 Hourly Flow Rate, HFR 84
 Percent Heavy Vehicles 55
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								318
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St. 9 12

Conflicting Flows 318
Potential Capacity 615
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity 615
Probability of Queue free St. 1.00 0.86

Step 2: LT from Major St. 4 1

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00
Maj L-Shared Prob Q free St.

Step 3: TH from Minor St. 8 11

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 0.86 1.00
Movement Capacity

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 8 11

Part 1 - First Stage

Conflicting Flows
Potential Capacity 900 475
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 900 475
Probability of Queue free St. 1.00 1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	475	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	475	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	531
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	531

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	742	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.86	1.00
Movement Capacity	641	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.86	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						84
Movement Capacity (vph)						615
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						615
Volume						84
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								84
C(m) (vph)								615
v/c								0.14
95% queue length								0.47
Control Delay								11.8
LOS								B
Approach Delay							11.8	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 2000
 Year : 2011 Existing Conditions
 N/S St: KWVP WB Off-Ramp/Mohr St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	101	152	179	225	300	41	96	86	211	43	41	52
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	283	848	0.41	0.33	26.2	C		
TR	583	1749	0.56	0.33	27.3	C	27.0	C
Westbound								
L	246	714	1.02	0.34	89.6	F		
TR	1148	3334	0.35	0.34	22.8	C	48.4	D
Northbound								
LTR	905	3257	0.44	0.28	28.2	C	28.2	C
Southbound								
L	384	1728	0.15	0.22	28.9	C		
TR	367	1650	0.25	0.22	30.3	C	29.8	C

Intersection Delay = 36.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 2000
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	101	152	179	225	300	41	96	86	211	43	41	52
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	29	43	51	63	91	13	26	23	57	14	13	17
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2000	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	115	325		250	403			395		57	90	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.261			0.000	
Prop RTs		0.468			0.092			0.506			0.400	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	101	152	179	225	300	41	96	86	211	43	41	52
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	115	173	152	250	366	37	103	92	200	57	54	36
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	115	325		250	403			395		57	90	
Prop LTs	1.000	0.000		1.000	0.000			0.261			0.000	
Prop RTs		0.468			0.092			0.506			0.400	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		2000	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.990	0.990		0.935	0.935			0.971		0.990	0.990	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.930			0.986			0.924			0.940	
fLT	0.466	1.000		0.409	1.000			0.987		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	848	1749		714	3334			3257		1728	1650	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	115	848	0.14	0.33	283	0.41
Prot							
Perm							
Thru	TR	325	1749	0.19	0.33	583	0.56
Right							
Westbound							
Prot							
Perm							
Left	L	250	714	# 0.35	0.34	246	1.02
Prot							
Perm							
Thru	TR	403	3334	0.12	0.34	1148	0.35
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	395	3257	# 0.12	0.28	905	0.44
Right							
Southbound							
Prot							
Perm							
Left	L	57	1728	0.03	0.22	384	0.15
Prot							
Perm							
Thru	TR	90	1650	# 0.05	0.22	367	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.41	0.33	23.1	1.000	283	0.50	3.0	0.0	26.2	C			
TR	0.56	0.33	24.6	1.000	583	0.50	2.7	0.0	27.3	C	27.0	C	
Westbound													
L	1.02	0.34	29.5	1.000	246	0.50	60.1	0.0	89.6	F			
TR	0.35	0.34	22.0	1.000	1148	0.50	0.8	0.0	22.8	C	48.4	D	
Northbound													
LTR	0.44	0.28	26.7	1.000	905	0.50	1.5	0.0	28.2	C	28.2	C	
Southbound													
L	0.15	0.22	28.2	1.000	384	0.50	0.8	0.0	28.9	C			
TR	0.25	0.22	28.8	1.000	367	0.50	1.5	0.0	30.3	C	29.8	C	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.261 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	2.86			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.095			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	403			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.092
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.1	0.00	0.0	0.0	26.2
TR	0.0	0.00	30.0	24.6	0.00	0.0	0.0	27.3
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	1.0	0.0	89.6
TR	0.0	0.00	29.5	22.0	0.00	0.0	0.0	22.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.7	0.00	0.0	0.0	28.2
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	28.9
TR	0.0	0.00	35.0	28.8	0.00	0.0	0.0	30.3
	0.0						0.0	

Intersection Delay	36.1	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	115	325		250	211		207			57	90	
So	1900	1900		2000	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	848	1749		714	1751		1710			1728	1650	
LnCapacity	283	583		246	602		475			384	367	
Flow Ratio	0.1	0.2		0.4	0.1		0.1			0.0	0.1	
v/c Ratio	0.41	0.56		1.02	0.35		0.44			0.15	0.25	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.2	6.7		6.3	3.9		4.3			1.1	1.9	
kB	0.3	0.5		0.4	0.8		0.7			0.6	0.5	
Q2	0.2	0.7		3.8	0.4		0.5			0.1	0.2	
Q Average	2.4	7.3		10.1	4.3		4.8			1.2	2.0	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	3.1	9.0		12.2	5.4		5.9			1.6	2.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.6	
BOQ	3.9	10.8		14.5	6.6		7.2			2.0	3.2	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.6	1.7		1.7			1.9	1.8	
BOQ	4.4	11.8		15.8	7.4		8.1			2.4	3.7	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.8		1.7	2.0		2.0			2.4	2.3	
BOQ	5.4	13.4		17.5	8.8		9.5			3.0	4.6	
QSRatio												
98th Percentile Output:												
fB%	2.6	2.0		1.9	2.3		2.3			2.9	2.7	
BOQ	6.4	15.0		19.1	10.1		10.9			3.6	5.5	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						445		
Peak-Hour Factor, PHF						0.89		
Hourly Flow Rate, HFR						500		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		432						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		464						
Percent Heavy Vehicles		3						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			464						
C(m) (vph)			529						
v/c			0.88						
95% queue length			9.74						
Control Delay			42.9						
LOS			E						
Approach Delay				42.9					
Approach LOS				E					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					445	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					125	
Hourly Flow Rate, HFR					500	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	432					
Peak Hour Factor, PHF	0.93					
Peak-15 Minute Volume	116					
Hourly Flow Rate, HFR	464					
Percent Heavy Vehicles	3					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			500					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 2: LT from Major St.		4		1
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Maj L-Shared Prob Q free St.				
Step 3: TH from Minor St.		8		11
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 4: LT from Minor St.		7		10
Conflicting Flows		500		
Potential Capacity		529		
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor				1.00
Maj. L, Min T Adj. Imp Factor.				1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity		529		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 500
Potential Capacity 529
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 529

Results for Two-stage process:
a
y
C t 529

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	464					
Movement Capacity (vph)	529					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	529					
Volume	464					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			464					
C(m) (vph)			529					
v/c			0.88					
95% queue length			9.74					
Control Delay			42.9					
LOS			E					
Approach Delay				42.9				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Mohr Street & Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Mohr Street
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	94	27	137	124	0	12	0	64	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.87	0.87	0.91	0.91	0.76	0.76		
Flow Rate	54	85	218	68	15	84		
% Heavy Veh	7	7	1	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	54	85	218	68	15	84		
Left-Turn	0	0	150	0	15	0		
Right-Turn	0	31	0	0	0	84		
Prop. Left-Turns	0.0	0.0	0.7	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

hRT-adj	-0.7	-0.7	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	-0.1	0.2

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	54	85	218	68	15	84		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.05	0.08	0.19	0.06	0.01	0.07		
hd, final value	5.10	4.85	5.21	4.87	5.10	4.30		
x, final value	0.08	0.11	0.32	0.09	0.02	0.10		
Move-up time, m		2.3		2.3		2.0		
Service Time	2.8	2.5	2.9	2.6	3.1	2.3		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	54	85	218	68	15	84		
Service Time	2.8	2.5	2.9	2.6	3.1	2.3		
Utilization, x	0.08	0.11	0.32	0.09	0.02	0.10		
Dep. headway, hd	5.10	4.85	5.21	4.87	5.10	4.30		
Capacity	304	335	468	318	265	334		
Delay	8.23	8.17	10.30	8.06	8.21	7.78		
LOS	A	A	B	A	A	A		
Approach:								
Delay		8.20		9.76		7.84		
LOS		A		A		A		
Intersection Delay	8.98							

Intersection LOS A

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	49	94	263	92	257	9	194	95	95	20	292	115
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	1207	2716	0.38	0.44	17.6	B	17.6	B
-----	------	------	------	------	------	---	------	---

Westbound

LTR	1121	2523	0.39	0.44	17.7	B	17.7	B
-----	------	------	------	------	------	---	------	---

Northbound

DefL	396	891	0.53	0.44	23.1	C		
TR	799	1798	0.26	0.44	16.4	B	19.8	B

Southbound

LTR	1300	2924	0.35	0.44	17.2	B	17.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	49	94	263	92	257	9	194	95	95	20	292	115
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	14	27	75	28	78	3	52	26	26	5	78	31
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		462			436		209	204			454	
%InSharedLn												
Prop LTs		0.121			0.257		1.000	0.000			0.046	
Prop RTs		0.647			0.025			0.500			0.269	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	49	94	263	92	257	9	194	95	95	20	292	115
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	56	107	299	112	313	11	209	102	102	21	311	122
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	462			436			209 204			454		
Prop LTs	0.121			0.257			1.000 0.000			0.046		
Prop RTs	0.647			0.025			0.500			0.269		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.903			0.996			0.925			0.960		
fLT	0.848			0.714			0.458 1.000			0.937		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2716			2523			891 1798			2924		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	462	2716	0.17	0.44	1207	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	436	2523	# 0.17	0.44	1121	0.39
Right							
Northbound							
Prot							
Perm							
Left	DefL	209	891	# 0.23	0.44	396	0.53
Prot							
Perm							
Thru	TR	204	1798	0.11	0.44	799	0.26
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	454	2924	0.16	0.44	1300	0.35
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.38	0.44	16.7	1.000	1207	0.50	0.8	0.0	17.6	B	17.6	B
Westbound												
LTR	0.39	0.44	16.8	1.000	1121	0.50	0.9	0.0	17.7	B	17.7	B
Northbound												
DefL	0.53	0.44	18.1	1.000	396	0.50	5.0	0.0	23.1	C		
TR	0.26	0.44	15.7	1.000	799	0.50	0.8	0.0	16.4	B	19.8	B
Southbound												
LTR	0.35	0.44	16.4	1.000	1300	0.50	0.7	0.0	17.2	B	17.2	B

Intersection delay = 18.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			40.0	
Effective permitted green time for LT lane group, g(s)			40.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			209	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			454	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			5.22	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.96	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			2.63	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			37.37	
n=Max(gq-gf)/2,0)			1.32	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.04	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.31	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.10	
gdifff=max(gq-gf,0)			2.63	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.46	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.458	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	40.0	40.0		40.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0		40.0
Opposing effective green time, go (s)	40.0	40.0		40.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	56	112	21
Proportion of LT in LT lane group, PLT	0.121	0.257	0.000
Proportion of LT in opposing flow, PLTo	0.26	0.12	0.00
Adjusted opposing flow rate, Vo (veh/h)	436	462	204
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.40	2.80	0.53
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.72	6.07	2.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	8.0	1.3	17.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	2.29	2.79	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	31.98	37.21	22.05
n=Max(gq-gf)/2,0)	0.00	0.74	0.00
PTHo=1-PLTo	0.74	0.88	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.30	0.72	0.10
EL1 (refer to Exhibit C16-3)	2.21	2.27	1.71
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.09	0.05
gdifff=max(gq-gf,0)	0.00	1.47	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.79	0.52	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.848	0.714	0.937

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		40.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	2.29	2.79		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.057	0.070		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	436	462		204
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.121	0.257		0.046
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	40.0	40.0	40.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.647	0.025	0.500
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	16.7	0.00	0.0	0.0	17.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	16.8	0.00	0.0	0.0	17.7
	0.0						0.0	
Northbound								
DefL	0.0	0.00	25.0	18.1	0.00	0.0	0.0	23.1
TR	0.0	0.00	25.0	15.7	0.00	0.0	0.0	16.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	16.4	0.00	0.0	0.0	17.2
	0.0						0.0	
Intersection Delay			18.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	242		228		209	204	238	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	2 0	0	0 2 0		0 2 0	
SL	1426		1325		891	1798	1535	
LnCapacity	633		588		396	799	682	
Flow Ratio	0.2		0.2		0.2	0.1	0.2	
v/c Ratio	0.38		0.39		0.53	0.26	0.35	
Grn Ratio	0.44		0.44		0.44	0.44	0.44	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.0		3.8		3.8	3.2	3.9	
kB	0.7		0.7		0.6	1.0	0.9	
Q2	0.4		0.5		0.6	0.3	0.5	
Q Average	4.5		4.3		4.4	3.5	4.4	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	5.6		5.3		5.5	4.4	5.4	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.5	1.5	1.5	
BOQ	6.8		6.5		6.8	5.5	6.7	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.7	1.7	1.7	
BOQ	7.7		7.3		7.6	6.2	7.5	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.0		2.0	2.1	2.0	
BOQ	9.0		8.7		8.9	7.4	8.8	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.3		2.3	2.4	2.3	
BOQ	10.4		10.0		10.3	8.6	10.2	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 08/04/2010
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	659	283	4	3	293	329	2	3	2	90	0	260
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	865	1728	0.85	0.73	17.8	B		
TR	1205	1643	0.26	0.73	4.3	A	13.7	B
Westbound								
LT	584	1876	0.53	0.31	27.9	C	30.3	C
R	497	1599	0.70	0.31	32.5	C		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.55	0.16	45.3	D		
LT	283	1818	0.00	0.16	32.1	C	20.2	C
R	862	1492	0.38	0.58	11.5	B		

Intersection Delay = 20.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 08/04/2010
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	659	283	4	3	293	329	2	3	2	90	0	260
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
PK 15 Vol	183	79	1	1	77	87	1	2	1	28	0	81
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	732	318			311	346		17		112	0	325
%InSharedLn										0		
Prop LTs	1.000	0.000			0.010			0.294		1.000	0.000	
Prop RTs		0.013			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.687			0.650			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		33.0	28.0					14.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	659	283	4	3	293	329	2	3	2	90	0	260
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
Adj flow	732	314	4	3	308	346	5	7	5	112	0	325
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	732	318			311	346		17		112	0	325
Prop LTs	1.000	0.000			0.010			0.294		1.000	0.000	
Prop RTs		0.013			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.998		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.347											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1643		1876	1599		952			1310	1818	1492
Sec.	631											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		634	1728	# 0.37	0.367	634	1.00
Perm		98	631	0.16	0.367	231	0.42
Left	L	732			0.73	865	0.85
Prot							
Perm							
Thru	TR	318	1643	0.19	0.73	1205	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	311	1876	0.17	0.31	584	0.53
Right	R	346	1599	# 0.22	0.31	497	0.70
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	112	1310	# 0.09	0.16	204	0.55
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	325	1492	0.22	0.58	862	0.38

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.67$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.80$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.85	0.73	10.6	1.000	865	0.50	7.1	0.0	17.8	B		
TR	0.26	0.73	4.0	1.000	1205	0.50	0.4	0.0	4.3	A	13.7	B
Westbound												
LT	0.53	0.31	25.6	1.000	584	0.50	2.3	0.0	27.9	C	30.3	C
R	0.70	0.31	27.3	1.000	497	0.50	5.2	0.0	32.5	C		
Northbound												
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C
Southbound												
L	0.55	0.16	35.1	1.000	204	0.50	10.2	0.0	45.3	D		
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	20.2	C

R 0.38 0.58 10.3 1.000 862 0.50 1.3 0.0 11.5 B

Intersection delay = 20.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	732			112
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	311			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.30			2.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.78			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	12.95			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.05			14.00
n=Max(gq-gf)/2,0)	6.47			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.75			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	6.31			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	12.95			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.35			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.347			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.010	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	318	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.95	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	1.92	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		318		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.010		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	66.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	66.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.013
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	732			
v/c ratio from Capacity Worksheet, X	0.85			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	12.95			
Unopposed green interval, gu	20.05			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.29			
XPerm	1.16			
XProt	0.73			
Case	3			
Queue at beginning of green arrow, Qa	5.81			
Queue at beginning of unsaturated green, Qu	2.63			
Residual queue, Qr	0.93			
Uniform Delay, d1	10.6			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		10.6	0.00	0.0	0.0	17.8
TR	0.0	0.00	12.0	4.0	0.00	0.0	0.0	4.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	25.6	0.00	0.0	0.0	27.9
R	0.0	0.00	31.0	27.3	0.00	0.0	0.0	32.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	35.1	0.00	0.0	0.0	45.3
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.3	0.00	0.0	0.0	11.5
Intersection Delay			20.2	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	732	318		311	346		17	112	0	325
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1180	1643		1876	1599		952	1310	1818	1492
LnCapacity	865	1205		584	497		148	204	283	862
Flow Ratio	0.6	0.2		0.2	0.2		0.0	0.1	0.0	0.2
v/c Ratio	0.85	0.26		0.53	0.70		0.11	0.55	0.00	0.38
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	7.1	2.6		6.4	7.6		0.4	2.6	0.0	4.4
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	3.3	0.3		0.6	1.0		0.0	0.4	0.0	0.6
Q Average	10.3	2.9		7.0	8.6		0.4	3.0	0.0	5.0
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2		1.3	1.3	1.3	1.2
BOQ	12.5	3.7		8.6	10.5		0.5	3.8	0.0	6.2
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5	1.5		1.7	1.6	1.7	1.5
BOQ	14.9	4.6		10.3	12.5		0.7	4.7	0.0	7.6
QSRatio										
90th Percentile Output:										
fB%	1.6	1.8		1.6	1.6		2.0	1.8	2.0	1.7
BOQ	16.2	5.2		11.3	13.7		0.8	5.4	0.0	8.4
QSRatio										
95th Percentile Output:										
fB%	1.7	2.2		1.8	1.8		2.5	2.1	2.6	2.0
BOQ	17.8	6.4		12.9	15.3		1.0	6.5	0.0	9.8
QSRatio										
98th Percentile Output:										
fB%	1.9	2.5		2.1	2.0		3.1	2.5	3.2	2.3
BOQ	19.5	7.5		14.5	16.9		1.2	7.6	0.0	11.3
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: AS	Inter.: Boscombe Ave & Tyrellan Ave
Agency: Philip Habib & Associates	Area Type: All other areas
Date: 8/04/2011	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2011 Existing Conditions
Project ID: 1121A - Charleston	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	341	34	0	1	34	40	3	3	2	58	1	588
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	757	1513	0.50	0.50	17.3	B		
TR	1066	2132	0.04	0.50	11.5	B	16.7	B

LTR	1563	3126	0.04	0.50	11.6	B	11.6	B
-----	------	------	------	------	------	---	------	---

LTR	1220	3138	0.01	0.39	16.9	B	16.9	B
-----	------	------	------	------	------	---	------	---

LT	552	1419	0.11	0.39	18.0	B	22.8	C
R	616	1583	0.51	0.39	23.7	C		

Intersection Delay = 18.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	341	34	0	1	34	40	3	3	2	58	1	588
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	95	9	0	1	9	11	2	2	1	15	1	156
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	379	38			69			16			63	313
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.984	
Prop RTs		0.000			0.464			0.250			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	341	34	0	1	34	40	3	3	2	58	1	588
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	379	38	0	1	36	32	6	6	4	62	1	313
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	379	38			69			16			63	313
Prop LTs	1.000	0.000			0.014			0.375			0.984	
Prop RTs		0.000			0.464			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.930			0.962		1.000	0.850
fLT	0.710	1.000			0.954			0.910		0.762	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1513	2132			3126			3138		1419	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	379	1513	# 0.25	0.50	757	0.50
Prot							
Perm							
Thru	TR	38	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	69	3126	0.02	0.50	1563	0.04
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3138	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	63	1419	0.04	0.39	552	0.11
Right	R	313	1583	# 0.20	0.39	616	0.51

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.45$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.50$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.50	0.50	15.0	1.000	757	0.50	2.2	0.0	17.3	B		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	16.7	B
Westbound												
LTR	0.04	0.50	11.5	1.000	1563	0.50	0.1	0.0	11.6	B	11.6	B
Northbound												
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.11	0.39	17.6	1.000	552	0.50	0.4	0.0	18.0	B	22.8	C

R 0.51 0.39 20.9 1.000 616 0.50 2.8 0.0 23.7 C

Intersection delay = 18.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	379			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	69			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	9.48			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.91			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.41			
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.710			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	62	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.984
Proportion of LT in opposing flow, PLTo	0.00	0.98	0.38	
Adjusted opposing flow rate, Vo (veh/h)	38	63	16	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.55	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.47	1.58	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	5.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	29.54	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.02	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.98	
EL1 (refer to Exhibit C16-3)	1.43	1.47	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.762	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	69	38	63	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.984
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.464	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.0	0.00	0.0	0.0	17.3
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.0
R	0.0	0.00	27.5	20.9	0.00	0.0	0.0	23.7
Intersection Delay			18.9	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	379	38			36			8			63	313
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1513	2132			1641			1648			1419	1583
LnCapacity	757	1066			820			640			552	616
Flow Ratio	0.3	0.0			0.0			0.0			0.0	0.2
v/c Ratio	0.50	0.04			0.04			0.01			0.11	0.51
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.952			1.000			1.000			0.937	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	6.3	0.5			0.5			0.1			1.0	6.0
kB	0.9	1.1			1.0			0.8			0.7	0.8
Q2	0.9	0.0			0.0			0.0			0.1	0.8
Q Average	7.2	0.5			0.5			0.1			1.1	6.7
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	8.8	0.7			0.7			0.2			1.4	8.3
QSRatio												
85th Percentile Output:												
fB%	1.5	1.7			1.7			1.7			1.6	1.5
BOQ	10.6	0.9			0.8			0.2			1.8	9.9
QSRatio												
90th Percentile Output:												
fB%	1.6	2.0			2.0			2.0			1.9	1.6
BOQ	11.7	1.0			1.0			0.3			2.1	11.0
QSRatio												
95th Percentile Output:												
fB%	1.8	2.5			2.5			2.6			2.4	1.9
BOQ	13.2	1.3			1.3			0.3			2.6	12.5
QSRatio												
98th Percentile Output:												
fB%	2.1	3.1			3.1			3.2			2.9	2.1
BOQ	14.8	1.6			1.5			0.4			3.2	14.1
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	136		22				2	207			336	259
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		19.0					31.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.29	0.32	16.7	B	16.4	B
R	473	1495	0.04	0.32	14.3	B		
Westbound								

Intersection Delay = 9.8 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	136		22				2	207		336	259	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	39		6				1	59		92	71	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	156		18					237			654	
%InSharedLn												
Prop LTs								0.008			0.000	
Prop RTs			1.000					0.000			0.436	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	136		22				2	207		336	259	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	156		18				2	235		369	285	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	156		18					237			654	
Prop LTs								0.008			0.000	
Prop RTs			1.000					0.000			0.436	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.926	0.926			0.990	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.935		
fLT	0.950				0.952	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1727	1495			3352	3757		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	156	1727	# 0.09	0.32	547	0.29
Prot							
Perm							
Thru							
Right	R	18	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	237	3352	0.07	0.52	1732	0.14
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	654	3757	# 0.17	0.52	1941	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.26
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.32

Control Delay and LOS Determination															
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach				
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS			
Eastbound															
L	0.29	0.32	15.4	1.000	547	0.50	1.3	0.0	16.7	B	16.4	B			
R	0.04	0.32	14.2	1.000	473	0.50	0.1	0.0	14.3	B					
Westbound															
Northbound															
LT	0.14	0.52	7.5	1.000	1732	0.50	0.2	0.0	7.7	A	7.7	A			
Southbound															
TR	0.34	0.52	8.5	1.000	1941	0.50	0.4	0.0	8.9	A	8.9	A			

Intersection delay = 9.8 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.008 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	654
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.72
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	1.84
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02
EL1 (refer to Exhibit C16-3)	2.76
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.952

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			1.84	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.059	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			654	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.008	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.436
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.4	0.00	0.0	0.0	16.7
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.3
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.5	0.00	0.0	0.0	7.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	8.5	0.00	0.0	0.0	8.9
	0.0						0.0	
Intersection Delay			9.8	sec/veh	Intersection LOS		A	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	156	18				124		343	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1727	1495				1760		1973	
LnCapacity	547	473				909		1019	
Flow Ratio	0.1	0.0				0.1		0.2	
v/c Ratio	0.29	0.04				0.14		0.34	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	2.0	0.2				1.1		3.3	
kB	0.5	0.5				0.8		0.7	
Q2	0.2	0.0				0.1		0.3	
Q Average	2.2	0.2				1.2		3.7	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.7	0.3				1.5		4.6	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.5	
BOQ	3.5	0.4				2.0		5.7	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.7	
BOQ	4.0	0.4				2.3		6.4	
QSRatio									
95th Percentile Output:									
fB%	2.2	2.6				2.4		2.1	
BOQ	4.9	0.6				2.9		7.7	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.1				2.9		2.4	
BOQ	5.8	0.7				3.5		8.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		428	2		4			21	167	4
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.40	0.42	14.2	B		
LT	576	1383	0.42	0.42	14.6	B	14.4	B

Northbound

L	449	1078	0.01	0.42	10.3	B	10.3	B
---	-----	------	------	------	------	---	------	---

Southbound

LTR	2047	4913	0.10	0.42	10.8	B	10.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		428	2		4			21	167	4
% Heavy Veh	1	1		3	3		1			1	1	1
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol	1	0		120	1		1			6	46	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			241	242		5			211		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.994		1.000				0.109	
Prop RTs	0.000			0.000						0.019		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.988		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		428	2		4			21	167	4
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	4	0		481	2		5			23	184	4
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	4			241	242		5			211		
Prop LTs	0.000			1.000 0.994			1.000			0.109		
Prop RTs	0.000			0.000						0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.997	
fLT	1.000		0.755 0.725		0.614		0.995	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1439 1383		1078		4913	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	241	1439	0.17	0.42	600	0.40
Prot							
Perm							
Thru	LT	242	1383	# 0.17	0.42	576	0.42
Right							
Northbound							
Prot							
Perm							
Left	L	5	1078	0.00	0.42	449	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	211	4913	# 0.04	0.42	2047	0.10
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.22
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.26

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.40	0.42	12.3	1.000	600	0.50	2.0	0.0	14.2	B			
LT	0.42	0.42	12.4	1.000	576	0.50	2.2	0.0	14.6	B	14.4	B	
Northbound													
L	0.01	0.42	10.3	1.000	449	0.50	0.0	0.0	10.3	B			
											10.3	B	
Southbound													
LTR	0.10	0.42	10.7	1.000	2047	0.50	0.1	0.0	10.8	B	10.8	B	

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		241	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.11	
Adjusted opposing flow rate, Vo (veh/h)		4	211	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.02	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	1.29	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	25.00	
n=Max(gq-gf)/2,0)		0.00	0.00	
PTHo=1-PLTo		1.00	0.89	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	1.63	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.61	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.614	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	240		
Proportion of LT in LT lane group, PLT	0.000	0.994	0.109
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.00		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound		
LaneGroup	TR		L	LT	L			LTR		
Init Queue	0.0		0.0	0.0	0.0			0.0		
Flow Rate	4		241	242	5			77		
So	1900		1900	1900	1900			1900		
No.Lanes	0	1	0	1	0	0	0	0	3	0
SL	1881		1439	1383	1078			1803		
LnCapacity	784		600	576	449			751		
Flow Ratio	0.0		0.2	0.2	0.0			0.0		
v/c Ratio	0.01		0.40	0.42	0.01			0.10		
Grn Ratio	0.42		0.42	0.42	0.42			0.42		
I Factor	1.000		0.983		0.988			1.000		
AT or PVG	3		3	3	3			3		
Pltn Ratio	1.00		1.00	1.00	1.00			1.00		
PF2	1.00		1.00	1.00	1.00			1.00		
Q1	0.0		2.8	2.9	0.0			0.8		
kB	0.7		0.6	0.6	0.5			0.7		
Q2	0.0		0.4	0.4	0.0			0.1		
Q Average	0.0		3.2	3.3	0.1			0.9		
Q Spacing	25.0		25.0	25.0	25.0			25.0		
Q Storage	0		0	0	0			0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3		1.3	1.3	1.3			1.3		
BOQ	0.1		4.0	4.1	0.1			1.1		
QSRatio										
85th Percentile Output:										
fB%	1.7		1.6	1.6	1.7			1.7		
BOQ	0.1		5.0	5.1	0.1			1.4		
QSRatio										
90th Percentile Output:										
fB%	2.0		1.8	1.8	2.0			1.9		
BOQ	0.1		5.7	5.7	0.1			1.7		
QSRatio										
95th Percentile Output:										
fB%	2.6		2.1	2.1	2.6			2.4		
BOQ	0.1		6.8	6.9	0.1			2.1		
QSRatio										
98th Percentile Output:										
fB%	3.2		2.5	2.5	3.2			3.0		
BOQ	0.1		8.0	8.1	0.2			2.6		
QSRatio										

ERROR MESSAGES

No errors to report.

Vehicle Volumes and Adjustments

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			329			
Peak Hour Factor, PHF			0.88			
Hourly Flow Rate, HFR			373			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					373			
C(m) (vph)					1047			
v/c					0.36			
95% queue length					1.63			
Control Delay					10.3			
LOS					B			
Approach Delay				10.3				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/03/2011
 Analysis Time Period:
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		22				
Peak-Hour Factor, PHF		0.71				
Peak-15 Minute Volume		8				
Hourly Flow Rate, HFR		30				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			329			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			93			
Hourly Flow Rate, HFR			373			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					30			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	30	
Potential Capacity	1047	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1047	
Probability of Queue free St.	0.64	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.64
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.64
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			373			
Movement Capacity (vph)			1047			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1047			
Volume			373			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					373			
C(m) (vph)					1047			
v/c					0.36			
95% queue length					1.63			
Control Delay					10.3			
LOS					B			
Approach Delay				10.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

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Phone:
E-Mail:

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ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	95	36	73	74	0	0	0	0	22	83	23
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	162		187				69 71	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	162		187				69	71
Left-Turn	0		93				24	0
Right-Turn	44		0				0	25
Prop. Left-Turns	0.0		0.5				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.4
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

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Phone:
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-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/03/2011
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	36	81	0	0	86	18	61	93	111	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	145		133		107		159	
% Heavy Veh	2		5		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	145		133		107	159		
Left-Turn	44		0		61	0		
Right-Turn	0		23		0	112		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.2		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	159	95	107	7	44	8	386	98	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	524	1496	0.57	0.35	20.3	C	19.1	B
R	560	1599	0.11	0.35	13.6	B		

Westbound

LTR	534	1526	0.13	0.35	13.8	B	13.8	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2302	4762	0.24	0.48	9.3	A	9.3	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 13.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	159	95	107	7	44	8	386	98	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	47	28	31	2	13	2	108	28	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		299	64		68			546				
%InSharedLn												
Prop LTs		0.625			0.118			0.795				
Prop RTs		0.000	1.000		0.132			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0						29.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	159	95	107	7	44	8	386	98	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	187	112	64	8	51	9	434	110	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		299	64		68			546				
Prop LTs		0.625			0.118			0.795				
Prop RTs		0.000	1.000		0.132			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.990			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.982			0.999	
fLT	0.770			0.960			0.962	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1496	1599		1526			4762	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.57	0.35	15.8	1.000	524	0.50	4.5	0.0	20.3	C	19.1	B
R	0.11	0.35	13.2	1.000	560	0.50	0.4	0.0	13.6	B		
Westbound												
LTR	0.13	0.35	13.3	1.000	534	0.50	0.5	0.0	13.8	B	13.8	B
Northbound												
LTR	0.24	0.48	9.0	1.000	2302	0.50	0.2	0.0	9.3	A	9.3	A
Southbound												

Intersection delay = 13.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	187	8	
Proportion of LT in LT lane group, PLT	0.625	0.118	0.795
Proportion of LT in opposing flow, PLTo	0.12	0.63	
Adjusted opposing flow rate, Vo (veh/h)	68	299	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.12	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.13	4.98	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	5.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.88	0.37	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.63	0.12	
EL1 (refer to Exhibit C16-3)	1.48	1.88	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.77	0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.770	0.960	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	5.64		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.269		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	68	299	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.625	0.118	0.795	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.132	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	15.8	0.00	0.0	0.0	20.3
R	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.3	0.00	0.0	0.0	13.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.0	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			13.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	299	64	68	200			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1496	1599	1526	1748			
LnCapacity	524	560	534	845			
Flow Ratio	0.2	0.0	0.0	0.1			
v/c Ratio	0.57	0.11	0.13	0.24			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	4.0	0.7	0.8	1.9			
kB	0.5	0.6	0.6	0.7			
Q2	0.7	0.1	0.1	0.2			
Q Average	4.8	0.8	0.9	2.2			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	5.9	1.0	1.1	2.8			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.7	1.7	1.6			
BOQ	7.2	1.3	1.4	3.5			
QSRatio							
90th Percentile Output:							
fB%	1.7	1.9	1.9	1.8			
BOQ	8.1	1.5	1.6	4.0			
QSRatio							
95th Percentile Output:							
fB%	2.0	2.5	2.4	2.2			
BOQ	9.4	2.0	2.1	4.9			
QSRatio							
98th Percentile Output:							
fB%	2.3	3.0	3.0	2.7			
BOQ	10.8	2.4	2.5	5.8			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	65		32				17	426		427	42	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	451	1692	0.22	0.27	18.3	B	18.3	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1100	1942	0.47	0.57	8.9	A	8.9	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1127	1988	0.45	0.57	8.7	A	8.7	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 9.7 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	65		32				17	426		427	42	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	17		8				5	124		116	11	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		101						515			510	
%InSharedLn												
Prop LTs		0.673						0.039			0.000	
Prop RTs		0.327						0.000			0.090	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65		32				17	426		427	42	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	68		33				20	495		464	46	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		101						515			510	
Prop LTs		0.673						0.039			0.000	
Prop RTs		0.327						0.000			0.090	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.956						1.000			0.988		
fLT	0.967						0.976			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1692						1942			1988		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	101	1692	# 0.06	0.27	451	0.22
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	515	1942	# 0.27	0.57	1100	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	510	1988	0.26	0.57	1127	0.45
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.32

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.22	0.27	17.2	1.000	451	0.50	1.1	0.0	18.3	B	18.3	B
Westbound												
Northbound												
LT	0.47	0.57	7.7	1.000	1100	0.50	1.3	0.0	8.9	A	8.9	A
Southbound												
TR	0.45	0.57	7.6	1.000	1127	0.50	1.2	0.0	8.7	A	8.7	A

Intersection delay = 9.7 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		20		
Proportion of LT in LT lane group, PLT	0.673	0.039	0.000	
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		510		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.33		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.1		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43		
gq, (see Exhibit C16-4,5,6,7,8)		5.40		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.90		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04		
EL1 (refer to Exhibit C16-3)		2.32		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.976		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.40	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.159	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			510	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.039	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.090
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	17.2	0.00	0.0	0.0	18.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.7	0.00	0.0	0.0	8.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.6	0.00	0.0	0.0	8.7
	0.0						0.0	
Intersection Delay			9.7	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	101						515			510		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1692						1942			1988		
LnCapacity	451						1100			1127		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.22						0.47			0.45		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.3						5.1			5.0		
kB	0.5						0.8			0.8		
Q2	0.1						0.7			0.7		
Q Average	1.5						5.8			5.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	1.9						7.1			6.9		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	2.4						8.6			8.4		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7		
BOQ	2.7						9.6			9.4		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	3.4						11.0			10.8		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.2			2.2		
BOQ	4.1						12.5			12.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	112		80				21	388		366		83
Lane Width		16.0						16.0		16.0		
RTOR Vol			0									21

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	570	1711	0.42	0.33	17.6	B	17.6	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	896	1791	0.53	0.50	12.1	B	12.1	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	997	1993	0.47	0.50	11.2	B	11.2	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 12.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	112		80				21	388		366	83	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	35		25				6	113		99	23	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		240						475			465	
%InSharedLn												
Prop LTs		0.583						0.051			0.000	
Prop RTs	0.417						0.000			0.144		
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	112		80				21	388		366	83	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	140		100				24	451		398	67	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		240						475			465	
Prop LTs		0.583						0.051			0.000	
Prop RTs		0.417						0.000			0.144	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.944						1.000			0.981		
fLT	0.972						0.968			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1711						1791			1993		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	240	1711	# 0.14	0.33	570	0.42
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	475	1791	# 0.27	0.50	896	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	465	1993	0.23	0.50	997	0.47
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.41

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.49

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.42	0.33	15.5	1.000	570	0.50	2.1	0.0	17.6	B	17.6	B
Westbound												
Northbound												
LT	0.53	0.50	10.2	1.000	896	0.50	1.9	0.0	12.1	B	12.1	B
Southbound												
TR	0.47	0.50	9.8	1.000	997	0.50	1.4	0.0	11.2	B	11.2	B

Intersection delay = 12.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		24	
Proportion of LT in LT lane group, PLT	0.583	0.051	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		465	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.40	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.75	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		13.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		6.28	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.50	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.22	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.968	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			6.28	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.209	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		465	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.583		0.051	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.417	0.144
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	15.5	0.00	0.0	0.0	17.6
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	10.2	0.00	0.0	0.0	12.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	9.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Intersection Delay			12.8	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	240						475			465		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1711						1791			1993		
LnCapacity	570						896			997		
Flow Ratio	0.1						0.3			0.2		
v/c Ratio	0.42						0.53			0.47		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.1						5.4			5.1		
kB	0.5						0.7			0.8		
Q2	0.4						0.7			0.7		
Q Average	3.5						6.1			5.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	4.4						7.5			7.0		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	5.4						9.1			8.5		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.7		
BOQ	6.1						10.1			9.5		
QSRatio												
95th Percentile Output:												
fB%	2.1						1.9			1.9		
BOQ	7.3						11.6			11.0		
QSRatio												
98th Percentile Output:												
fB%	2.4						2.1			2.2		
BOQ	8.5						13.1			12.4		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Vets Rd E & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		110	242	432	256	49	183		454	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	31.4	C
R	220	1652	0.53	0.13	31.7	C		
Westbound								
LTR	1328	4688	0.80	0.28	22.5	C	22.5	C
Northbound								
L	124	373	0.43	0.33	25.3	C		
T	616	1848	0.32	0.33	16.2	B	18.1	B
Southbound								
TR	670	2009	0.79	0.33	26.1	C	26.1	C

Intersection Delay = 23.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		110	242	432	256	49	183		454	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		29	69	123	73	13	50		130	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		116		1057		53	199			528	
%InSharedLn												
Prop LTs					0.260		1.000	0.000			0.000	
Prop RTs			1.000		0.275			0.000			0.011	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		110	242	432	256	49	183		454	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		116	275	491	291	53	199		522	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		116		1057		53	199		528		
Prop LTs					0.260		1.000	0.000		0.000		
Prop RTs			1.000		0.275			0.000		0.011		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.990	0.990	0.980	0.980	0.962	0.962
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.972	0.972
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.959	0.959		1.000	0.998	0.998
fLT	0.950		0.987	0.987	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4688	4688	373	1848	2009	2009
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	116	1652	# 0.07	0.13	220	0.53
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1057	4688	# 0.23	0.28	1328	0.80
Right							
Northbound							
Prot							
Perm							
Left	L	53	373	0.14	0.33	124	0.43
Prot							
Perm							
Thru	T	199	1848	0.11	0.33	616	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	528	2009	# 0.26	0.33	670	0.79
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.56

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	31.4	C	
R	0.53	0.13	24.2	1.000	220	0.50	7.5	0.0	31.7	C			
Westbound													
LTR	0.80	0.28	19.9	1.000	1328	0.50	2.6	0.0	22.5	C	22.5	C	
Northbound													
L	0.43	0.33	15.5	1.000	124	0.50	9.7	0.0	25.3	C	18.1	B	
T	0.32	0.33	14.9	1.000	616	0.50	1.3	0.0	16.2	B			
Southbound													
TR	0.79	0.33	18.1	1.000	670	0.50	8.0	0.0	26.1	C	26.1	C	

Intersection delay = 23.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			53	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			528	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			0.88	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.80	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			11.86	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			8.14	
n=Max(gq-gf)/2,0)			5.93	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.14	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.260 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			11.86	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.593	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			528	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)		17.0		20.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		17.0		20.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.275	0.011
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	24.2	0.00	0.0	0.0	31.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.9	0.00	0.0	0.0	22.5
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.5	0.00	0.0	0.0	25.3
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.1	0.00	0.0	0.0	26.1
	0.0						0.0	
Intersection Delay			23.4	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	116		388		53	199		528
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1720		373	1848		2009
LnCapacity	222	220		487		124	616		670
Flow Ratio	0.0	0.1		0.2		0.1	0.1		0.3
v/c Ratio	0.02	0.53		0.80		0.43	0.32		0.79
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.8		6.0		0.7	2.5		8.0
kB	0.3	0.3		0.3		0.2	0.6		0.6
Q2	0.0	0.3		0.9		0.1	0.3		1.9
Q Average	0.1	2.1		6.9		0.8	2.7		9.8
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	2.6		8.5		1.1	3.5		12.0
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.7	1.6		1.4
BOQ	0.1	3.3		10.2		1.4	4.3		14.2
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.1	3.8		11.3		1.6	4.9		15.5
QSRatio									
95th Percentile Output:									
fB%	2.6	2.3		1.8		2.4	2.2		1.7
BOQ	0.2	4.7		12.8		2.0	6.0		17.1
QSRatio									
98th Percentile Output:									
fB%	3.2	2.7		2.1		3.0	2.6		1.9
BOQ	0.2	5.6		14.4		2.4	7.1		18.8
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: S Service Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	9	19	6				8	223	113	296	462	48
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	459	1621	0.12	0.28	16.5	B	16.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LTR	952	1731	0.39	0.55	8.9	A	8.9	A
-----	-----	------	------	------	-----	---	-----	---

Southbound

L	556	1011	0.57	0.55	11.3	B		
TR	985	1791	0.54	0.55	9.9	A	10.4	B

Intersection Delay = 10.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	19	6				8	223	113	296	462	48
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				2	61	31	80	124	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig			LTR						LTR	L		TR
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		54						374		318	536	
%InSharedLn												
Prop LTs		0.259						0.024		1.000	0.000	
Prop RTs		0.185						0.329			0.073	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	19	6				8	223	113	296	462	48
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
Adj flow	14	30	10				9	242	123	318	497	39
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	54						374			318	536	
Prop LTs	0.259						0.024			1.000	0.000	
Prop RTs	0.185						0.329			0.073		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.980	0.980	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.992			1.000	0.972	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.975							0.956				0.989	
fLT	0.987							0.989			0.542	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1621							1731			1011	1791	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	54	1621	# 0.03	0.28	459	0.12
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	374	1731	0.22	0.55	952	0.39
Right							
Southbound							
Prot							
Perm							
Left	L	318	1011	# 0.31	0.55	556	0.57
Prot							
Perm							
Thru	TR	536	1791	0.30	0.55	985	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.12	0.28	15.9	1.000	459	0.50	0.5	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.39	0.55	7.7	1.000	952	0.50	1.1	0.0	8.9	A	8.9	A
Southbound												
L	0.57	0.55	8.9	1.000	556	0.50	2.4	0.0	11.3	B		
TR	0.54	0.55	8.7	1.000	985	0.50	1.2	0.0	9.9	A	10.4	B

Intersection delay = 10.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				318
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				374
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.30
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.23
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.54
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.46
n=Max(gq-gf)/2,0)				1.77
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.85
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.76
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.54
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.542

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		9	
Proportion of LT in LT lane group, PLT	0.259	0.024	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		536	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.15	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.93	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		6.24	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		11.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.989	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.24	3.54
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.189	0.107
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			536	374
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.024	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.185	0.329	0.073
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.9	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.7	0.00	0.0	0.0	8.9
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.9	0.00	0.0	0.0	11.3
TR	0.0	0.00	13.5	8.7	0.00	0.0	0.0	9.9
	0.0						0.0	

Intersection Delay	10.2	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	54						374			318	536	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1621						1731			1011	1791	
LnCapacity	459						952			556	985	
Flow Ratio	0.0						0.2			0.3	0.3	
v/c Ratio	0.12						0.39			0.57	0.54	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.922				0.564	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	0.7						3.6			3.5	5.7	
kB	0.5						0.8			0.3	0.5	
Q2	0.1						0.5			0.4	0.6	
Q Average	0.7						4.1			3.9	6.3	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	0.9						5.1			4.9	7.7	
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.5	1.5	
BOQ	1.2						6.2			6.0	9.4	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7	1.6	
BOQ	1.4						7.0			6.7	10.3	
QSRatio												
95th Percentile Output:												
fB%	2.5						2.0			2.1	1.9	
BOQ	1.8						8.3			8.0	11.9	
QSRatio												
98th Percentile Output:												
fB%	3.0						2.4			2.4	2.1	
BOQ	2.2						9.6			9.3	13.4	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Amboy Rd & Bloomingdale Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	12	19	248	27	102	17	236	162	87	347	48
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 633 1425 0.08 0.44 14.7 B 14.7 B

Westbound

L 561 1263 0.51 0.44 20.9 C
 T 792 1783 0.04 0.44 14.2 B 19.1 B
 R 585 1316 0.20 0.44 15.9 B

Northbound

LTR 728 1637 0.62 0.44 21.8 C 21.8 C

Southbound

LTR 656 1476 0.84 0.44 25.5 C 25.5 C

Intersection Delay = 22.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	12	19	248	27	102	17	236	162	87	347	48
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	4	7	71	8	29	5	64	44	25	100	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		53		285	31	117		451			554	
%InSharedLn												
Prop LTs		0.170		1.000	0.000			0.040			0.181	
Prop RTs		0.509			0.000	1.000		0.390			0.099	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	12	19	248	27	102	17	236	162	87	347	48
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	17	27	285	31	117	18	257	176	100	399	55
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	53			285	31	117	451			554		
Prop LTs	0.170			1.000	0.000	0.000	0.040			0.181		
Prop RTs	0.509			0.000 1.000			0.390			0.099		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.980			0.971	0.971	0.971	0.990			0.980		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	0.992			1.000	1.000	0.992	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.931			1.000 0.850			0.947			0.987		
fLT	0.974			0.722	1.000		0.971			0.807		
Sec.												
fLpb	1.000			0.948	1.000		1.000			0.995		
fRpb	0.971			1.000 1.000			0.978			1.000		
S	1425			1263	1783	1316	1637			1476		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	53	1425	0.04	0.44	633	0.08
Right							
Westbound							
Prot							
Perm							
Left	L	285	1263	# 0.23	0.44	561	0.51
Prot							
Perm							
Thru	T	31	1783	0.02	0.44	792	0.04
Right	R	117	1316	0.09	0.44	585	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	451	1637	0.28	0.44	728	0.62
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	554	1476	# 0.38	0.44	656	0.84
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.60$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.68$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.08	0.44	14.4	1.000	633	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.51	0.44	17.9	1.000	561	0.50	3.0	0.0	20.9	C		
T	0.04	0.44	14.1	1.000	792	0.50	0.1	0.0	14.2	B	19.1	B
R	0.20	0.44	15.2	1.000	585	0.50	0.7	0.0	15.9	B		
Northbound												
LTR	0.62	0.44	19.2	1.000	728	0.50	2.6	0.0	21.8	C	21.8	C
Southbound												
LTR	0.84	0.44	22.2	1.000	656	0.50	3.3	0.0	25.5	C	25.5	C

Intersection delay = 22.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		285		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.17		
Adjusted opposing flow rate, Vo (veh/h)		53		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.13		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.33		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.83		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.38		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.722		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	18	100
Proportion of LT in LT lane group, PLT	0.170	0.000	0.040
Proportion of LT in opposing flow, PLTo	0.00	0.18	0.04
Adjusted opposing flow rate, Vo (veh/h)	31	554	451
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.45	2.50
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	13.85	11.27
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	18.8	3.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.63	11.78
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	21.23	28.22
n=Max(gq-gf)/2,0)	0.00	0.00	4.06
PTHo=1-PLTo	1.00	0.82	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.17	0.04	0.18
EL1 (refer to Exhibit C16-3)	1.42	2.43	2.19
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	3.82
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	8.12
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.97	0.81
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.974	0.971	0.807

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.63	11.78
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.366	0.295
OCCpedu	0.000	0.056	0.000	0.048
Opposing flow rate, Vo (veh/h)	31	53	554	451
OCCr	0.000	0.052	0.000	0.026
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.974
Proportion of left turns, PLT	0.170	1.000	0.040	0.181
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.995
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.509	1.000	0.390	0.099
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.4	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	17.9	0.00	0.0	0.0	20.9
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.9
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	19.2	0.00	0.0	0.0	21.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	22.2	0.00	0.0	0.0	25.5
	0.0						0.0	
Intersection Delay			22.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		53	285	31	117		451		554
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1425	1263	1783	1316		1637		1476
LnCapacity		633	561	792	585		728		656
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.08	0.51	0.04	0.20		0.62		0.84
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.905			0.663		0.229
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	5.1	0.4	1.8		8.6		12.3
kB		0.8	0.7	0.9	0.7		0.6		0.2
Q2		0.1	0.7	0.0	0.2		1.0		1.0
Q Average		0.8	5.8	0.5	2.0		9.6		13.3
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.1	7.2	0.6	2.5		11.7		16.1
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.4	8.7	0.8	3.1		13.9		18.9
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		1.6	9.6	0.9	3.6		15.1		20.4
QSRatio									
95th Percentile Output:									
fB%		2.4	1.9	2.5	2.3		1.7		1.7
BOQ		2.1	11.1	1.2	4.5		16.8		22.2
QSRatio									
98th Percentile Output:									
fB%		3.0	2.2	3.1	2.7		1.9		1.8
BOQ		2.5	12.6	1.5	5.3		18.4		24.0
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS
 Agency: Philip Habib & Associates
 Date: 8/04/2011
 Period: Weekday 5-6 PM Peak Period
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2011 Existing Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	119		235	19	131		134		27			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	924	1848	0.39	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	934	1867	0.19	0.50	12.9	B	12.9	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	581	1493	0.41	0.39	22.0	C	22.0	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 16.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		119	235	19	131		134		27			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		36	72	6	39		50		10			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59						0			
Adj Flow		360			181			240				
%InSharedLn												
Prop LTs		0.000			0.127			0.833				
Prop RTs		0.597			0.000			0.167				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		119	235	19	131		134		27			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		145	215	23	158		200		40			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		360			181			240				
Prop LTs		0.000			0.127			0.833				
Prop RTs		0.597			0.000			0.167				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.919			1.000			0.978					
fLT	1.000			0.936			0.960					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1848			1867			1493					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	360	1848	# 0.19	0.50	924	0.39
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	181	1867	0.10	0.50	934	0.19
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	240	1493	# 0.16	0.39	581	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.39	0.50	14.0	1.000	924	0.50	1.1	0.0	15.1	B	15.1	B
Westbound												
LT	0.19	0.50	12.5	1.000	934	0.50	0.5	0.0	12.9	B	12.9	B
Northbound												
LR	0.41	0.39	20.0	1.000	581	0.50	2.0	0.0	22.0	C	22.0	C
Southbound												

Intersection delay = 16.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	23		
Proportion of LT in LT lane group, PLT	0.000	0.127	0.833
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	360		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	0.57		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.00		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.5		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	7.64		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.48		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.13		
EL1 (refer to Exhibit C16-3)	2.00		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.936		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
TR	0.0						0.0	
	0.0	0.00	22.5	14.0	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
LT	0.0						0.0	
	0.0	0.00	22.5	12.5	0.00	0.0	0.0	12.9
	0.0						0.0	
Northbound								
LR	0.0						0.0	
	0.0	0.00	27.5	20.0	0.00	0.0	0.0	22.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			16.7	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		360			181			240				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1848			1867			1493				
LnCapacity		924			934			581				
Flow Ratio		0.2			0.1			0.2				
v/c Ratio		0.39			0.19			0.41				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.989			0.917				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.6			2.5			4.4				
kB		1.0			1.1			0.7				
Q2		0.6			0.3			0.5				
Q Average		6.2			2.8			4.9				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.3			1.2				
BOQ		7.6			3.5			6.0				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.6			1.5				
BOQ		9.2			4.3			7.4				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.8			1.7				
BOQ		10.2			4.9			8.2				
QSRatio												
95th Percentile Output:												
fB%		1.9			2.2			2.0				
BOQ		11.7			6.0			9.6				
QSRatio												
98th Percentile Output:												
fB%		2.1			2.6			2.3				
BOQ		13.3			7.1			11.0				
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	 	4 L	5 T	6 R
Volume		11	176	42		27	194	26
Peak-Hour Factor, PHF		0.92	0.92	0.92		0.88	0.88	0.88
Hourly Flow Rate, HFR		11	191	45		30	220	29
Percent Heavy Vehicles		3	--	--		5	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	 	10 L	11 T	12 R
Volume		51	16	38		25	31	22
Peak Hour Factor, PHF		0.78	0.78	0.78		0.40	0.40	0.40
Hourly Flow Rate, HFR		65	20	48		62	77	54
Percent Heavy Vehicles		0	0	0		0	0	0
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage		No			/	No		
Lanes		0	1	0		0	1	0
Configuration		LTR				LTR		

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config	LTR		LTR			LTR				LTR	
v (vph)	11		30			133				193	
C(m) (vph)	1311		1314			439				475	
v/c	0.01		0.02			0.30				0.41	
95% queue length	0.03		0.07			1.26				1.95	
Control Delay	7.8		7.8			16.7				17.7	
LOS	A		A			C				C	
Approach Delay						16.7				17.7	
Approach LOS						C				C	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Sharrotts Road
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume	11	176	42	27	194	26
Peak-Hour Factor, PHF	0.92	0.92	0.92	0.88	0.88	0.88
Peak-15 Minute Volume	3	48	11	8	55	7
Hourly Flow Rate, HFR	11	191	45	30	220	29
Percent Heavy Vehicles	3	--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		
Upstream Signal?	No			No		
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	51	16	38	25	31	22
Peak Hour Factor, PHF	0.78	0.78	0.78	0.40	0.40	0.40
Peak-15 Minute Volume	16	5	12	16	19	14
Hourly Flow Rate, HFR	65	20	48	62	77	54
Percent Heavy Vehicles	0	0	0	0	0	0
Percent Grade (%)	0				0	
Flared Approach: Exists?/Storage			No	/		No /
RT Channelized?						
Lanes	0	1	0	0	1	0
Configuration	LTR			LTR		

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:	191	220
Shared ln volume, major rt vehicles:	45	29
Sat flow rate, major th vehicles:	1700	1700
Sat flow rate, major rt vehicles:	1700	1700
Number of major street through lanes:	1	1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)	4.1	4.1	7.1	6.5	6.2	7.1	6.5	6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)	3	5	0	0	0	0	0	0
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage	4.1	4.2	7.1	6.5	6.2	7.1	6.5	6.2
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)	2.20	2.20	3.50	4.00	3.30	3.50	4.00	3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)	3	5	0	0	0	0	0	0
t(f)	2.2	2.2	3.5	4.0	3.3	3.5	4.0	3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x	249	236	596	545	214	564	552	234
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x) s P(x) V(c,u,x)		1500		1500		1500		1500
C(r,x) C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows		214		234
Potential Capacity		831		810
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		831		810
Probability of Queue free St.		0.94		0.93
Step 2: LT from Major St.		4		1
Conflicting Flows		236		249
Potential Capacity		1314		1311
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity		1314		1311
Probability of Queue free St.		0.98		0.99
Maj L-Shared Prob Q free St.		0.97		0.99
Step 3: TH from Minor St.		8		11
Conflicting Flows		545		552
Potential Capacity		449		444
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		0.96		0.96
Movement Capacity		433		428
Probability of Queue free St.		0.95		0.82
Step 4: LT from Minor St.		7		10
Conflicting Flows		596		564
Potential Capacity		418		439
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor		0.79		0.92
Maj. L, Min T Adj. Imp Factor.		0.84		0.94
Cap. Adj. factor due to Impeding mvmnt		0.78		0.88
Movement Capacity		327		388

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	545	552
Potential Capacity	449	444
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity	433	428

Result for 2 stage process:

a		
y		
C t	433	428
Probability of Queue free St.	0.95	0.82

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage

Conflicting Flows	596	564
Potential Capacity	418	439
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	0.79	0.92
Maj. L, Min T Adj. Imp Factor.	0.84	0.94
Cap. Adj. factor due to Impeding mvmnt	0.78	0.88
Movement Capacity	327	388

Results for Two-stage process:

a		
y		
C t	327	388

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	65	20	48	62	77	54
Movement Capacity (vph)	327	433	831	388	428	810
Shared Lane Capacity (vph)		439			475	

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	327	433	831	388	428	810
Volume	65	20	48	62	77	54
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		439			475	
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config	LTR	LTR		LTR			LTR	
v (vph)	11	30		133			193	
C(m) (vph)	1311	1314		439			475	
v/c	0.01	0.02		0.30			0.41	
95% queue length	0.03	0.07		1.26			1.95	
Control Delay	7.8	7.8		16.7			17.7	
LOS	A	A		C			C	
Approach Delay				16.7			17.7	
Approach LOS				C			C	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	0.99	0.98
v(i1), Volume for stream 2 or 5	191	220
v(i2), Volume for stream 3 or 6	45	29
s(i1), Saturation flow rate for stream 2 or 5	1700	1700
s(i2), Saturation flow rate for stream 3 or 6	1700	1700
P*(oj)	0.99	0.97
d(M,LT), Delay for stream 1 or 4	7.8	7.8
N, Number of major street through lanes	1	1
d(rank,1) Delay for stream 2 or 5	0.1	0.2

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		211	12			15	252	
Peak-Hour Factor, PHF		0.92	0.92			0.88	0.88	
Hourly Flow Rate, HFR		229	13			17	286	
Percent Heavy Vehicles		--	--			5	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		9		18				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		12		24				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			17			36					
C(m) (vph)			1307			657					
v/c			0.01			0.05					
95% queue length			0.04			0.17					
Control Delay			7.8			10.8					
LOS			A			B					
Approach Delay						10.8					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		211	12	15	252	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		57	3	4	72	
Hourly Flow Rate, HFR		229	13	17	286	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	9		18			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	12		24			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		286
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		242	556		236			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	236	
Potential Capacity	801	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	801	
Probability of Queue free St.	0.97	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	242	
Potential Capacity	1307	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1307	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	556	
Potential Capacity	490	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.96
Movement Capacity	484	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 556
Potential Capacity 490
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.96
Movement Capacity 484

Results for Two-stage process:

a
y
C t 484

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	12		24			
Movement Capacity (vph)	484		801			
Shared Lane Capacity (vph)		657				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	484		801			
Volume	12		24			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		657				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		17		36				
C(m) (vph)		1307		657				
v/c		0.01		0.05				
95% queue length		0.04		0.17				
Control Delay		7.8		10.8				
LOS		A		B				
Approach Delay				10.8				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		286
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		7.8
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	9	5	246	25	320	5	145	313	126	183	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	724	1738	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	551	1323	0.53	0.42	16.3	B	17.7	B
R	539	1293	0.65	0.42	19.0	B		

Northbound

LTR	745	1788	0.68	0.42	18.6	B	18.6	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	512	1229	0.66	0.42	20.7	C	20.7	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	9	5	246	25	320	5	145	313	126	183	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	67	7	87	2	40	86	35	50	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		15			294	348		508			339	
%InSharedLn												
Prop LTs		0.000			0.908			0.010			0.407	
Prop RTs		0.333			0.000	1.000		0.677			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	9	5	246	25	320	5	145	313	126	183	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	10	5	267	27	348	5	159	344	138	201	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	15			294 348			508			339		
Prop LTs	0.000			0.908			0.010			0.407		
Prop RTs	0.333			0.000 1.000			0.677			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.955			1.000 0.850			0.909			1.000		
fLT	1.000			0.735			0.997			0.593		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1738			1323 1293			1788			1229		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	15	1738	0.01	0.42	724	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	294	1323	0.22	0.42	551	0.53
Right	R	348	1293	# 0.27	0.42	539	0.65
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	508	1788	# 0.28	0.42	745	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	339	1229	0.28	0.42	512	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	724	0.50	0.1	0.0	10.3	B	10.3	B	
Westbound													
LT	0.53	0.42	13.1	1.000	551	0.50	3.1	0.0	16.3	B	17.7	B	
R	0.65	0.42	14.0	1.000	539	0.50	5.0	0.0	19.0	B			
Northbound													
LTR	0.68	0.42	14.3	1.000	745	0.50	4.3	0.0	18.6	B	18.6	B	
Southbound													
LTR	0.66	0.42	14.1	1.000	512	0.50	6.6	0.0	20.7	C	20.7	C	

Intersection delay = 18.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	267	5	138
Proportion of LT in LT lane group, PLT	0.000	0.908	0.010	0.407
Proportion of LT in opposing flow, PLTo	0.91	0.00	0.41	0.01
Adjusted opposing flow rate, Vo (veh/h)	294	15	339	508
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	4.45	0.08	2.30
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.90	0.25	5.65	8.47
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	4.37	0.00	5.44	9.21
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.63	25.00	9.12	15.79
n=Max(gq-gf)/2,0)	2.18	0.00	0.00	4.18
PTHo=1-PLTo	0.09	1.00	0.59	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.91	0.01	0.41
EL1 (refer to Exhibit C16-3)	1.87	1.40	1.96	2.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.10		1.00	4.11
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.11
gdifff=max(gq-gf,0)	4.37	0.00	0.00	8.36
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.73	1.00	0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.735	0.997	0.593

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	4.37		5.44	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.175		0.218	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	294		339	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.010	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.1	0.00	0.0	0.0	16.3
R	0.0	0.00	17.5	14.0	0.00	0.0	0.0	19.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.3	0.00	0.0	0.0	18.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.1	0.00	0.0	0.0	20.7
	0.0						0.0	
Intersection Delay			18.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	15			294	348	508			339			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1738			1323	1293	1788			1229			
LnCapacity	724			551	539	745			512			
Flow Ratio	0.0			0.2	0.3	0.3			0.3			
v/c Ratio	0.02			0.53	0.65	0.68			0.66			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.849		0.861			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			3.7	4.6	6.9			4.6			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			0.5	0.8	1.2			1.0			
Q Average	0.2			4.2	5.5	8.1			5.6			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			5.2	6.7	9.9			6.9			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.5			
BOQ	0.3			6.4	8.2	11.9			8.3			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.7	1.7	1.6			1.7			
BOQ	0.3			7.2	9.1	13.0			9.3			
QSRatio												
95th Percentile Output:												
fB%	2.6			2.0	1.9	1.8			1.9			
BOQ	0.4			8.6	10.6	14.6			10.7			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.3	2.2	2.0			2.2			
BOQ	0.5			9.9	12.0	16.2			12.2			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: No Bridge St & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				461		8		455			434	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2028 0.81 0.33 23.3 C 23.3 C

Northbound

T 1026 2051 0.49 0.50 11.3 B 11.3 B

Southbound

T 1027 2054 0.46 0.50 10.3 B 10.3 B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				461		8	455			434		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				134		2	125			119		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					545		500			477		
%InSharedLn												
Prop LTs					0.983		0.000			0.000		
Prop RTs					0.017		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0						30.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				461		8	455			434		
PHF				0.86		0.86	0.91			0.91		
Adj flow				536		9	500			477		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					545			500			477	
Prop LTs					0.983			0.000			0.000	
Prop RTs					0.017			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.998			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2028			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	545	2028	# 0.27	0.33	676	0.81
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	500	2051	# 0.24	0.50	1026	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	477	2054	0.23	0.50	1027	0.46
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.81	0.33	18.2	1.000	676	0.50	5.1	0.0	23.3	C	23.3	C
Northbound												
T	0.49	0.50	9.9	1.000	1026	0.50	1.4	0.0	11.3	B	11.3	B
Southbound												
T	0.46	0.50	9.8	1.000	1027	0.50	0.6	0.0	10.3	B	10.3	B

Intersection delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.983 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

60.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.2	0.00	0.0	0.0	23.3
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.9	0.00	0.0	0.0	11.3
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.8	0.00	0.0	0.0	10.3
	0.0						0.0	
Intersection Delay			15.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		455	234	168	727	
Peak-Hour Factor, PHF		0.91	0.91	0.91	0.91	
Peak-15 Minute Volume		125	64	46	200	
Hourly Flow Rate, HFR		499	257	184	798	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		798
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		756						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	756	
Potential Capacity	837	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	837	
Probability of Queue free St.	0.78	1.00
Maj L-Shared Prob Q free St.	0.59	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.59	0.59
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.78	0.78
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.59 0.59
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.78 0.78
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		184						
C(m) (vph)		837						
v/c		0.22						
95% queue length		0.84						
Control Delay		10.5						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.78
v(il), Volume for stream 2 or 5		798
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.59
d(M,LT), Delay for stream 1 or 4		10.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		4.4

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				89		166	523	74		105	622	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 394 1476 0.73 0.27 30.6 C 30.6 C

Northbound

TR 1133 1999 0.58 0.57 10.1 B 10.1 B

Southbound

LT 866 1529 0.92 0.57 17.6 B 17.6 B

Intersection Delay = 16.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				89		166	523	74		105	622	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				25		47	144	20		29	171	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					287			656			799	
%InSharedLn												
Prop LTs					0.348			0.000			0.144	
Prop RTs					0.652			0.123			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				89		166	523	74		105	622	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				100		187	575	81		115	684	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					287			656			799	
Prop LTs					0.348			0.000			0.144	
Prop RTs					0.652			0.123			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.912			0.983			1.000	
fLT					0.983			1.000			0.752	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1476			1999			1529	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	287	1476	# 0.19	0.27	394	0.73
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	656	1999	0.33	0.57	1133	0.58
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	799	1529	# 0.52	0.57	866	0.92
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.72
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.73	0.27	20.0	1.000	394	0.50	10.6	0.0	30.6	C	30.6	C
----	------	------	------	-------	-----	------	------	-----	------	---	------	---

Northbound

TR	0.58	0.57	8.4	1.000	1133	0.50	1.7	0.0	10.1	B	10.1	B
----	------	------	-----	-------	------	------	-----	-----	------	---	------	---

Southbound

LT	0.92	0.57	11.8	1.000	866	0.50	5.8	0.0	17.6	B	17.6	B
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Intersection delay = 16.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			115
Proportion of LT in LT lane group, PLT	0.348	0.000	0.144
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			656
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.92
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.93
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			4.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.41
n=Max(gq-gf)/2,0)			1.64
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.14
EL1 (refer to Exhibit C16-3)			2.68
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.752

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.59
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.223
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				656
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.144
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCcr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.652	0.123
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.0	0.00	0.0	0.0	30.6
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.4	0.00	0.0	0.0	10.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	11.8	0.00	0.0	0.0	17.6
	0.0						0.0	
Intersection Delay			16.9	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Richmond Valley Rd & Page Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	65	31	83	28	53	21	122	670	133	14	530	80
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	585	1697	0.39	0.34	23.4	C	23.4	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	532	1544	0.26	0.34	22.5	C	22.5	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	348	640	0.38	0.54	13.6	B		
TR	1065	1957	0.82	0.54	21.0	C	20.0-	B

Southbound

LTR	1483	2724	0.44	0.54	13.2	B	13.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	65	31	83	28	53	21	122	670	133	14	530	80
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	21	10	27	10	18	7	33	182	36	4	144	22
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		229			140		133	873			656	
%InSharedLn												
Prop LTs		0.362			0.271		1.000	0.000			0.023	
Prop RTs		0.463			0.207			0.166		0.099		
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65	31	83	28	53	21	122	670	133	14	530	80
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	83	40	106	38	73	29	133	728	145	15	576	65
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	229			140			133 873			656		
Prop LTs	0.362			0.271			1.000 0.000			0.023		
Prop RTs	0.463			0.207			0.166			0.099		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.938			0.972			0.975			0.985		
fLT	0.841			0.877			0.364 1.000			0.867		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1697			1544			640 1957			2724		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	229	1697	# 0.13	0.34	585	0.39
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	140	1544	0.09	0.34	532	0.26
Right							
Northbound							
Prot							
Perm							
Left	L	133	640	0.21	0.54	348	0.38
Prot							
Perm							
Thru	TR	873	1957	# 0.45	0.54	1065	0.82
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	656	2724	0.24	0.54	1483	0.44
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.39	0.34	22.4	1.000	585	0.50	1.1	0.0	23.4	C	23.4	C	
Westbound													
LTR	0.26	0.34	21.3	1.000	532	0.50	1.2	0.0	22.5	C	22.5	C	
Northbound													
L	0.38	0.54	11.8	1.000	348	0.50	1.8	0.0	13.6	B			
TR	0.82	0.54	16.9	1.000	1065	0.50	4.1	0.0	21.0	C	20.0-	B	
Southbound													
LTR	0.44	0.54	12.3	1.000	1483	0.50	0.9	0.0	13.2	B	13.2	B	

Intersection delay = 18.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			133	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.02	
Adjusted opposing flow rate, Vo (veh/h)			656	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			3.33	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.61	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			4.71	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			44.29	
n=Max(gq-gf)/2,0)			2.35	
PTHo=1-PLTo			0.98	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.48	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.32	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			4.71	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.36	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.364	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	83	38	15
Proportion of LT in LT lane group, PLT	0.362	0.271	0.000
Proportion of LT in opposing flow, PLTo	0.27	0.36	0.00
Adjusted opposing flow rate, Vo (veh/h)	140	229	873
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.08	0.95	0.38
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.50	5.72	21.83
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	2.9	8.5	26.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	3.20	6.94	33.61
gu=g-gq if gq>=gf, or = g-gf if gq<gf	27.80	22.52	15.39
n=Max(gq-gf)/2,0)	0.13	0.00	3.47
PTHo=1-PLTo	0.73	0.64	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.36	0.27	0.05
EL1 (refer to Exhibit C16-3)	1.60	1.75	3.30
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.08	0.04
gdifff=max(gq-gf,0)	0.26	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.84	0.88	0.82
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.841	0.877	0.867

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	3.20	6.94	4.71	33.61
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.103	0.224	0.096	0.686
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	140	229	656	873
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.362	0.271	1.000	0.023
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.463	0.207	0.166	0.099
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.4	0.00	0.0	0.0	23.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.3	0.00	0.0	0.0	22.5
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	11.8	0.00	0.0	0.0	13.6
TR	0.0	0.00	20.5	16.9	0.00	0.0	0.0	21.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	12.3	0.00	0.0	0.0	13.2
	0.0						0.0	
Intersection Delay			18.4	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	229		140		133	873	344	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 0	1 0	0	1 1 0	0 0	2 0	
SL	1697		1544		640	1957	1430	
LnCapacity	585		532		348	1065	778	
Flow Ratio	0.1		0.1		0.2	0.4	0.2	
v/c Ratio	0.39		0.26		0.38	0.82	0.44	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.3		2.5		1.9	18.0	5.2	
kB	0.4		0.7		0.3	0.7	0.9	
Q2	0.3		0.3		0.2	2.7	0.7	
Q Average	4.6		2.8		2.1	20.7	5.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.3	1.2	1.2	
BOQ	5.7		3.5		2.7	24.9	7.2	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.6	1.4	1.5	
BOQ	7.0		4.4		3.4	29.1	8.8	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.8	1.5	1.7	
BOQ	7.8		5.0		3.8	31.2	9.7	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.2		2.3	1.6	1.9	
BOQ	9.2		6.0		4.7	33.4	11.2	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.6		2.7	1.7	2.2	
BOQ	10.6		7.1		5.6	35.7	12.7	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: S Br St & Page Ave/Boscome Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	349						756			571		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.61	0.33	29.1	C	29.1	C

Westbound

Northbound

T 2134 3842 0.37 0.56 11.5 B 11.5 B

Southbound

T 1951 3512 0.32 0.56 11.2 B 11.2 B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	349						756			571		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	101						197			155		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	406						788			621		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	349						756			571		
PHF	0.86						0.96			0.92		
Adj flow	406						788			621		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	406						788			621		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.980						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2006						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	406	2006	# 0.20	0.33	669	0.61
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	788	3842	# 0.21	0.56	2134	0.37
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	621	3512	0.18	0.56	1951	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.61	0.33	25.1	1.000	669	0.50	4.1	0.0	29.1	C	29.1	C	
Westbound													
Northbound													
T	0.37	0.56	11.2	1.000	2134	0.50	0.3	0.0	11.5	B	11.5	B	
Southbound													
T	0.32	0.56	10.8	1.000	1951	0.50	0.4	0.0	11.2	B	11.2	B	

Intersection delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	25.1	0.00	0.0	0.0	29.1
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.2	0.00	0.0	0.0	11.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Intersection Delay			15.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	406						413		326	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2017		1844	
LnCapacity	669						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.61						0.37		0.32	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.567		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.5						5.8		4.4	
kB	0.9						0.7		1.1	
Q2	1.3						0.4		0.5	
Q Average	9.8						6.2		4.9	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	11.9						7.6		6.1	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	14.1						9.2		7.4	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	15.3						10.2		8.3	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.9		2.0	
BOQ	17.0						11.7		9.7	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.3	
BOQ	18.7						13.2		11.1	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						571	
Peak-Hour Factor, PHF						0.92	
Hourly Flow Rate, HFR						620	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							53
Peak Hour Factor, PHF							0.88
Hourly Flow Rate, HFR							60
Percent Heavy Vehicles							5
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								60
C(m) (vph)								723
v/c								0.08
95% queue length								0.27
Control Delay								10.4
LOS								B
Approach Delay							10.4	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 571
 Peak-Hour Factor, PHF 0.92
 Peak-15 Minute Volume 155
 Hourly Flow Rate, HFR 620
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 53
 Peak Hour Factor, PHF 0.88
 Peak-15 Minute Volume 15
 Hourly Flow Rate, HFR 60
 Percent Heavy Vehicles 5
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								310
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		310
Potential Capacity		723
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		723
Probability of Queue free St.	1.00	0.92
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.92	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	483
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	483
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	483	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	483	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	540
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	540

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	748	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.92	1.00
Movement Capacity	686	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.92	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						60
Movement Capacity (vph)						723
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						723
Volume						60
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								60
C(m) (vph)								723
v/c								0.08
95% queue length								0.27
Control Delay								10.4
LOS								B
Approach Delay							10.4	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Mohr St/KWVP
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Sat Flow Rate WB-L =2050
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	92	166	190	246	404	44	101	176	221	41	92	86
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	210	630	0.47	0.33	29.0	C		
TR	584	1751	0.57	0.33	27.4	C	27.8	C
Westbound								
L	249	722	1.05	0.34	98.1	F		
TR	1196	3473	0.47	0.34	24.2	C	47.8	D
Northbound								
LTR	935	3365	0.59	0.28	30.9	C	30.9	C
Southbound								
L	384	1728	0.13	0.22	28.6	C		
TR	362	1629	0.59	0.22	37.1	D	35.5	D

Intersection Delay = 37.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Mohr St/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L =2050
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Mohr St

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	92	166	190	246	404	44	101	176	221	41	92	86
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.94	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	25	45	51	65	129	14	28	49	61	12	27	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	99	331		262	560			554		49	212	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.202			0.000	
Prop RTs		0.462			0.075			0.444			0.481	
Peds Bikes	0			0		0		0		0		
Buses	0	0		0	0			0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Arriv. Type	3	3		3	3			3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
I Factor		0.700			0.903			1.000			0.855	
Lost Time	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0			2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	92	166	190	246	404	44	101	176	221	41	92	86
PHF	0.93	0.93	0.93	0.94	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	99	178	153	262	518	42	112	196	246	49	110	102
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	99	331		262	560		554			49	212	
Prop LTs	1.000	0.000		1.000	0.000		0.202			0.000		
Prop RTs	0.462			0.075			0.444			0.481		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.931			0.989		0.933				0.928	
fLT	0.346	1.000		0.389	1.000		0.990			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	630	1751		722	3473		3365			1728	1629	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	99	630	0.16	0.33	210	0.47
Prot							
Perm							
Thru	TR	331	1751	0.19	0.33	584	0.57
Right							
Westbound							
Prot							
Perm							
Left	L	262	722	# 0.36	0.34	249	1.05
Prot							
Perm							
Thru	TR	560	3473	0.16	0.34	1196	0.47
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	554	3365	# 0.16	0.28	935	0.59
Right							
Southbound							
Prot							
Perm							
Left	L	49	1728	0.03	0.22	384	0.13
Prot							
Perm							
Thru	TR	212	1629	# 0.13	0.22	362	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.47	0.33	23.7	1.000	210	0.50	5.2	0.0	29.0	C			
TR	0.57	0.33	24.7	1.000	584	0.50	2.8	0.0	27.4	C	27.8	C	
Westbound													
L	1.05	0.34	29.5	1.000	249	0.50	68.6	0.0	98.1	F			
TR	0.47	0.34	23.1	1.000	1196	0.50	1.2	0.0	24.2	C	47.8	D	
Northbound													
LTR	0.59	0.28	28.1	1.000	935	0.50	2.8	0.0	30.9	C	30.9	C	
Southbound													
L	0.13	0.22	28.0	1.000	384	0.50	0.6	0.0	28.6	C			
TR	0.59	0.22	31.3	1.000	362	0.50	5.8	0.0	37.1	D	35.5	D	

Intersection delay = 37.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	99	262		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	560	331		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/3600	2.48	6.55		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.35	8.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	6.52	9.52		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.48	21.48		
n=Max(gq-gf)/2,0)	3.26	4.76		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.26	1.78		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.35	0.39		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.346	0.389		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.202 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	6.52			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.217			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	560			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.075
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.7	0.00	0.0	0.0	29.0
TR	0.0	0.00	30.0	24.7	0.00	0.0	0.0	27.4
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	3.2	0.0	98.1
TR	0.0	0.00	29.5	23.1	0.00	0.0	0.0	24.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.1	0.00	0.0	0.0	30.9
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.0	0.00	0.0	0.0	28.6
TR	0.0	0.00	35.0	31.3	0.00	0.0	0.0	37.1
	0.0						0.0	

Intersection Delay	37.5	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	99	331		262	294		290			49	212	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	630	1751		722	1824		1767			1728	1629	
LnCapacity	210	584		249	628		491			384	362	
Flow Ratio	0.2	0.2		0.4	0.2		0.2			0.0	0.1	
v/c Ratio	0.47	0.57		1.05	0.47		0.59			0.13	0.59	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.0	6.8		6.6	5.7		6.3			1.0	4.7	
kB	0.3	0.5		0.4	0.7		0.7			0.5	0.5	
Q2	0.2	0.7		4.5	0.6		1.0			0.1	0.7	
Q Average	2.2	7.5		11.0	6.4		7.2			1.1	5.4	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	2.8	9.2		13.4	7.8		8.8			1.3	6.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.5	
BOQ	3.5	11.0		15.8	9.5		10.6			1.7	8.1	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.6	1.6		1.6			1.9	1.7	
BOQ	4.0	12.1		17.1	10.5		11.7			2.0	9.0	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.8		1.7	1.9		1.8			2.4	1.9	
BOQ	4.9	13.7		18.9	12.0		13.3			2.5	10.5	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0		1.9	2.1		2.1			2.9	2.2	
BOQ	5.8	15.3		20.6	13.5		14.8			3.1	11.9	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						528			
Peak-Hour Factor, PHF						0.93			
Hourly Flow Rate, HFR						567			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		207							
Peak Hour Factor, PHF		0.90							
Hourly Flow Rate, HFR		230							
Percent Heavy Vehicles		1							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			230							
C(m) (vph)			487							
v/c			0.47							
95% queue length			2.49							
Control Delay			18.8							
LOS			C							
Approach Delay				18.8						
Approach LOS				C						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 528
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 142
 Hourly Flow Rate, HFR 567
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 207
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 58
 Hourly Flow Rate, HFR 230
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
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Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	567	
Potential Capacity	487	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	487	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 567
Potential Capacity 487
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 487

Results for Two-stage process:
a
y
C t 487

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	230					
Movement Capacity (vph)	487					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	487					
Volume	230					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			230					
C(m) (vph)			487					
v/c			0.47					
95% queue length			2.49					
Control Delay			18.8					
LOS			C					
Approach Delay				18.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/04/2011
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Mohr Street & Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Mohr Street
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	185	31	103	166	0	53	0	88	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.85	0.85	0.91	0.91	0.89	0.89		
Flow Rate	108	145	204	91	59	98		
% Heavy Veh	0	0	0	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	108	145	204	91	59	98		
Left-Turn	0	0	113	0	59	0		
Right-Turn	0	36	0	0	0	98		
Prop. Left-Turns	0.0	0.0	0.6	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.2	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Veterans Rd W & Tyrellan Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL TR			LTR		
Volume	76	98	254	120	318	23	220	192	80	24	501	156
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 1069 2406 0.44 0.44 18.3 B 18.3 B

Westbound

LTR 1090 2452 0.54 0.44 20.0- B 20.0- B

Northbound

DefL 273 615 0.86 0.44 50.1 D
 TR 826 1858 0.36 0.44 17.8 B 32.0 C

Southbound

LTR 1332 2996 0.55 0.44 20.0+ C 20.0+ C

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	76	98	254	120	318	23	220	192	80	24	501	156
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	21	27	69	38	102	7	59	53	22	6	135	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		466			591		234	299			733	
%InSharedLn												
Prop LTs		0.178			0.261		1.000	0.000			0.035	
Prop RTs		0.592			0.049			0.294			0.229	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		40.0						40.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	76	98	254	120	318	23	220	192	80	24	501	156
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	83	107	276	154	408	29	234	211	88	26	539	168
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	466			591			234 299			733		
Prop LTs	0.178			0.261			1.000 0.000			0.035		
Prop RTs	0.592			0.049			0.294			0.229		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.911			0.993			0.956			0.966		
fLT	0.745			0.690			0.293 1.000			0.936		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2406			2452			615 1858			2996		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	466	2406	0.19	0.44	1069	0.44
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	591	2452	# 0.24	0.44	1090	0.54
Right							
Northbound							
Prot							
Perm							
Left	DefL	234	615	# 0.38	0.44	273	0.86
Prot							
Perm							
Thru	TR	299	1858	0.16	0.44	826	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	733	2996	0.24	0.44	1332	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.44	0.44	17.2	1.000	1069	0.50	1.1	0.0	18.3	B	18.3	B
Westbound												
LTR	0.54	0.44	18.3	1.000	1090	0.50	1.7	0.0	20.0-	B	20.0-	B
Northbound												
DefL	0.86	0.44	22.4	1.000	273	0.50	27.7	0.0	50.1	D		
TR	0.36	0.44	16.6	1.000	826	0.50	1.2	0.0	17.8	B	32.0	C
Southbound												
LTR	0.55	0.44	18.4	1.000	1332	0.50	1.6	0.0	20.0+	C	20.0+	C

Intersection delay = 22.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			40.0	
Effective permitted green time for LT lane group, g(s)			40.0	
Opposing effective green time, go (s)			40.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			234	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			733	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			5.85	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.62	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.56	
gq, (see Exhibit C16-4,5,6,7,8)			8.60	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			31.40	
n=Max(gq-gf)/2,0)			4.30	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.68	
EL2=Max((1-Ptho*n)/Plto, 1.0)			4.06	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.10	
gdifff=max(gq-gf,0)			8.60	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.293	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	40.0	40.0		40.0
Effective permitted green time for LT lane group, g(s)	40.0	40.0		40.0
Opposing effective green time, go (s)	40.0	40.0		40.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	83	154	26
Proportion of LT in LT lane group, PLT	0.178	0.261	0.000
Proportion of LT in opposing flow, PLTo	0.26	0.18	0.00
Adjusted opposing flow rate, Vo (veh/h)	591	466	299
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.08	3.85	0.65
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.76	6.12	3.74
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	4.0	0.0	15.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	5.42	2.87	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.58	37.13	24.07
n=Max(gq-gf)/2,0)	0.70	1.43	0.00
PTHo=1-PLTo	0.74	0.82	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51	0.77	0.08
EL1 (refer to Exhibit C16-3)	2.59	2.28	1.88
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.38	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.09	0.05
gdif=max(gq-gf,0)	1.39	2.87	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.58	0.47	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.745	0.690	0.936

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		40.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	5.42	2.87		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.135	0.072		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	591	466		299
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.178	0.261		0.035
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	40.0	40.0	40.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.592	0.049	0.294
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	17.2	0.00	0.0	0.0	18.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	18.3	0.00	0.0	0.0	20.0-
	0.0						0.0	
Northbound								
DefL	0.0	0.00	25.0	22.4	0.00	0.0	0.0	50.1
TR	0.0	0.00	25.0	16.6	0.00	0.0	0.0	17.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	18.4	0.00	0.0	0.0	20.0+
	0.0						0.0	
Intersection Delay			22.4	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	244		310		234	299	384	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1263		1287		615	1858	1573	
LnCapacity	561		572		273	826	699	
Flow Ratio	0.2		0.2		0.4	0.2	0.2	
v/c Ratio	0.43		0.54		0.86	0.36	0.55	
Grn Ratio	0.44		0.44		0.44	0.44	0.44	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.2		5.7		5.3	4.9	7.1	
kB	0.6		0.7		0.5	1.0	0.9	
Q2	0.5		0.8		2.0	0.6	1.1	
Q Average	4.7		6.4		7.2	5.5	8.1	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	5.8		7.9		8.8	6.8	9.9	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.5	1.5	1.5	
BOQ	7.1		9.6		10.6	8.3	11.8	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.6		1.6	1.7	1.6	
BOQ	7.9		10.6		11.7	9.2	13.0	
QSRatio								
95th Percentile Output:								
fB%	2.0		1.9		1.8	1.9	1.8	
BOQ	9.3		12.1		13.3	10.6	14.6	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.1		2.1	2.2	2.0	
BOQ	10.7		13.6		14.8	12.1	16.2	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS

Agency: Philip Habib & Associates

Date: 08/04/2010

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: 1121A - Charleston

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Sat Flw Rate EB-L = 2100

Year : 2011 Existing Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	776	329			378	462				152		193
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						119						0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	P		
Thru		P			Thru			
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	895	1909	0.89	0.72	26.3	C		
T	1170	1646	0.29	0.71	5.1	A	19.9	B
Westbound								
T	460	1881	0.87	0.24	37.1	D	38.3	D
R	391	1599	0.91	0.24	39.7	D		
Northbound								
Southbound								
L	576	3239	0.29	0.18	33.3	C		
							18.7	B
R	962	1492	0.22	0.64	7.1	A		
Intersection Delay = 25.8 (sec/veh)					Intersection LOS = C			

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 08/04/2010
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	776	329			378	462				152		193
% Heavy Veh	1	1			1	1				1		1
PHF	0.97	0.96			0.94	0.97				0.92		0.92
PK 15 Vol	200	86			101	119				41		52
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat	2100	1900			1900	1900				1900		1900
ParkExist												
NumPark			X									
			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						119						0
Adj Flow	800	343			402	354				165		210
%InSharedLn												
Prop LTs	1.000	0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0		0			0		
Buses	0	0			0	0				0		0
%InProtPhase	50.0											
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0				0.0		0.0
Arriv. Type	3	3			3	3				3		3
Unit Ext.	3.0	3.0			3.0	3.0				3.0		3.0
I Factor		0.508			0.176						1.000	
Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Ext of g	3.0	2.0			2.0	2.0				2.0		2.0
Ped Min g					24.6			3.2			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	776	329			378	462							152		193
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	800	343			402	354							165		210
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R							L		R
Adj flow	800	343			402	354							165		210
Prop LTs	1.000	0.000			0.000										
Prop RTs		0.000			0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound	
	L	T			T	R			L	T	R		L	R
So	2100	1900			1900	1900			1900				1900	1900
Lanes	1	1	0	0	1	1	0	0	0				2	0
fW	0.967	1.000			1.000	1.000							0.933	0.933
fHV	0.990	0.990			0.990	0.990							0.990	0.990
fG	1.000	1.000			1.000	1.000*							1.000	1.000
fP	1.000	0.875			1.000	1.000							1.000	1.000
fBB	1.000	1.000			1.000	1.000							1.000	1.000
fA	1.000	1.000			1.000	1.000							1.000	1.000
fLU	1.000	1.000			1.000	1.000							0.971	1.000
fRT		1.000			1.000	0.850								0.850
fLT	0.950	1.000			1.000								0.950	
Sec.	0.148													
fLpb	1.000	1.000			1.000								1.000	
fRpb		1.000			1.000	1.000								1.000
S	1909	1646			1881	1599							3239	1492
Sec.	298													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

R 0.22 0.64 6.6 1.000 962 0.50 0.5 0.0 7.1 A

Intersection delay = 25.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			
Effective permitted green time for LT lane group, g(s)	27.0			
Opposing effective green time, go (s)	22.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	800			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	402			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	20.00			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.05			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			
gq, (see Exhibit C16-4,5,6,7,8)	19.55			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45			
n=Max(gq-gf)/2,0)	9.78			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.90			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	800			
v/c ratio from Capacity Worksheet, X	0.89			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	19.55			
Unopposed green interval, gu	7.45			
Red time r=(C-g-gq-gu)	25.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.30			
XPerm	2.68			
XProt	0.69			
Case	3			
Queue at beginning of green arrow, Qa	9.32			
Queue at beginning of unsaturated green, Qu	4.35			
Residual queue, Qr	3.76			
Uniform Delay, d1	18.9			

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		18.9	0.00	0.0	0.0	26.3
T	0.0	0.00	13.0	4.7	0.00	0.0	0.0	5.1
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	34.0	32.7	0.00	0.0	0.0	37.1
R	0.0	0.00	34.0	33.0	0.00	0.0	0.0	39.7
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.1	0.00	0.0	0.0	33.3
	0.0						0.0	
R	0.0	0.00	16.0	6.6	0.00	0.0	0.0	7.1
Intersection Delay			25.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	800	343		402	354				84	210
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1240	1646		1881	1599				1668	1492
LnCapacity	895	1170		460	391				296	962
Flow Ratio	0.6	0.2		0.2	0.2				0.1	0.1
v/c Ratio	0.89	0.29		0.87	0.91				0.28	0.22
Grn Ratio	0.72	0.71		0.24	0.24				0.18	0.64
I Factor		0.508		0.176					1.000	
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00	1.00				1.00	1.00
Q1	8.9	3.1		9.7	8.6				1.8	2.2
kB	0.5	0.6		0.1	0.1				0.5	1.1
Q2	3.5	0.3		0.7	0.8				0.2	0.3
Q Average	12.4	3.4		10.4	9.4				2.0	2.5
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2				1.3	1.3
BOQ	15.0	4.2		12.6	11.5				2.5	3.1
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.4	1.4				1.6	1.6
BOQ	17.7	5.3		14.9	13.6				3.2	3.9
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.6				1.8	1.8
BOQ	19.1	6.0		16.2	14.9				3.7	4.5
QSRatio										
95th Percentile Output:										
fB%	1.7	2.1		1.7	1.8				2.3	2.2
BOQ	20.9	7.2		17.9	16.5				4.6	5.5
QSRatio										
98th Percentile Output:										
fB%	1.8	2.5		1.9	1.9				2.7	2.6
BOQ	22.7	8.4		19.6	18.2				5.4	6.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: AS	Inter.: Boscombe Ave & Tyrellan Ave
Agency: Philip Habib & Associates	Area Type: All other areas
Date: 8/04/2011	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2011 Existing Conditions
Project ID: 1121A - Charleston	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	438	43	0	0	43	54	0	0	1	78	0	797
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	741	1482	0.62	0.50	19.9	B		
TR	1066	2132	0.04	0.50	11.6	B	19.2	B

LTR	1634	3267	0.06	0.50	11.6	B	11.6	B
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	548	1408	0.15	0.39	18.4	B	26.6	C
R	622	1599	0.69	0.39	28.3	C		

Intersection Delay = 22.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	438	43	0	0	43	54	0	0	1	78	0	797
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	114	11	0	0	12	15	0	0	1	21	0	214
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	456	45			91			1			84	429
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0		0	0	
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.967			1.000			1.000			0.855	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	438	43	0	0	43	54	0	0	1	78	0	797
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	456	45	0	0	47	44	0	0	1	84	0	429
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	456	45			91			1			84	429
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.990	0.990
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.927			0.850		1.000	0.850
fLT	0.695	1.000			1.000			1.000		0.748	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1482	2132			3267			3045		1408	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	456	1482	# 0.31	0.50	741	0.62
Prot							
Perm							
Thru	TR	45	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	91	3267	0.03	0.50	1634	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	84	1408	0.06	0.39	548	0.15
Right	R	429	1599	# 0.27	0.39	622	0.69

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.62	0.50	16.3	1.000	741	0.50	3.7	0.0	19.9	B			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	19.2	B	
Westbound													
LTR	0.06	0.50	11.6	1.000	1634	0.50	0.1	0.0	11.6	B	11.6	B	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.15	0.39	17.9	1.000	548	0.50	0.5	0.0	18.4	B	26.6	C	

R 0.69 0.39 23.0 1.000 622 0.50 5.3 0.0 28.3 C

Intersection delay = 22.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	456			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	91			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	11.40			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.19			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.44			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.70			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.695			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	84
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	45	84	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.10
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.56	2.10	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.20
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.44	1.50	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.748

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	91	45	84	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.484	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	16.3	0.00	0.0	0.0	19.9
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.9	0.00	0.0	0.0	18.4
R	0.0	0.00	27.5	23.0	0.00	0.0	0.0	28.3
Intersection Delay			22.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	456	45			47			0			84	429
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1482	2132			1715			1599			1408	1599
LnCapacity	741	1066			858			621			548	622
Flow Ratio	0.3	0.0			0.0			0.0			0.1	0.3
v/c Ratio	0.62	0.04			0.05			0.00			0.15	0.69
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.967			1.000			1.000			0.855	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	8.2	0.6			0.6			0.0			1.4	9.0
kB	0.9	1.2			1.0			0.8			0.6	0.7
Q2	1.4	0.1			0.1			0.0			0.1	1.5
Q Average	9.6	0.6			0.7			0.0			1.5	10.4
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	11.7	0.8			0.9			0.0			1.9	12.6
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.7			1.7			1.6	1.4
BOQ	13.9	1.0			1.1			0.0			2.4	15.0
QSRatio												
90th Percentile Output:												
fB%	1.6	1.9			1.9			2.0			1.9	1.6
BOQ	15.1	1.2			1.3			0.0			2.8	16.3
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.5			2.6			2.3	1.7
BOQ	16.8	1.6			1.6			0.0			3.5	18.0
QSRatio												
98th Percentile Output:												
fB%	1.9	3.0			3.0			3.2			2.8	1.9
BOQ	18.5	1.9			2.0			0.0			4.2	19.7
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	240		33				5	197			428	443
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.49	0.32	19.3	B	18.8	B
R	497	1568	0.06	0.32	14.5	B		
Westbound								
Northbound								
LT	1699	3288	0.14	0.52	7.7	A	7.7	A
Southbound								
TR	1937	3750	0.51	0.52	9.9	A	9.9	A

Intersection Delay = 11.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	240		33				5	197		428	443	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	71		10				2	56		120	124	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	282		28					230			979	
%InSharedLn												
Prop LTs								0.026			0.000	
Prop RTs			1.000					0.000			0.509	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	240		33				5	197		428	443	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	282		28				6	224		481	498	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	282		28					230			979	
Prop LTs								0.026			0.000	
Prop RTs			1.000					0.000			0.509	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.971	0.971			0.990		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.924	
fLT	0.950				0.934		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1811	1568			3288		3750	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	282	1811	# 0.16	0.32	573	0.49
Prot							
Perm							
Thru							
Right	R	28	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	230	3288	0.07	0.52	1699	0.14
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	979	3750	# 0.26	0.52	1937	0.51
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.42

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.49	0.32	16.6	1.000	573	0.50	2.7	0.0	19.3	B	18.8	B	
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B			
Westbound													
Northbound													
LT	0.14	0.52	7.5	1.000	1699	0.50	0.2	0.0	7.7	A	7.7	A	
Southbound													
TR	0.51	0.52	9.5	1.000	1937	0.50	0.5	0.0	9.9	A	9.9	A	

Intersection delay = 11.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.026 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	979
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.57
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	6.60
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.83
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.05
EL1 (refer to Exhibit C16-3)	3.83
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.60	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.213	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			979	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.026	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.509
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	16.6	0.00	0.0	0.0	19.3
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.5	0.00	0.0	0.0	7.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.5	0.00	0.0	0.0	9.9
	0.0						0.0	
Intersection Delay			11.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	282	28				120		514	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1726		1969	
LnCapacity	573	497				892		1017	
Flow Ratio	0.2	0.0				0.1		0.3	
v/c Ratio	0.49	0.06				0.13		0.51	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	3.8	0.3				1.0		5.6	
kB	0.5	0.5				0.8		0.4	
Q2	0.5	0.0				0.1		0.4	
Q Average	4.3	0.4				1.2		6.0	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	5.3	0.5				1.5		7.4	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.5	
BOQ	6.6	0.6				1.9		9.0	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.6	
BOQ	7.4	0.7				2.2		10.0	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.5				2.4		1.9	
BOQ	8.7	0.9				2.8		11.5	
QSRatio									
98th Percentile Output:									
fB%	2.3	3.1				2.9		2.1	
BOQ	10.0	1.1				3.4		13.0	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Englewood Ave @ Veterans Rd W
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Volume	1	0		658	2		5			26	213	1
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	606	1454	0.89	0.42	34.0	C		
LT	583	1399	0.31	0.42	13.1	B	28.8	C

Northbound

L	428	1027	0.01	0.42	10.3	B	10.3	B
---	-----	------	------	------	------	---	------	---

Southbound

LTR	2032	4876	0.13	0.42	10.9	B	10.9	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 23.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		658	2		5			26	213	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		181	1		2			7	60	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			542	183		6			269		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.988		1.000				0.108	
Prop RTs	0.000			0.000						0.004		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		658	2		5			26	213	1
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	4	0		723	2		6			29	239	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			542	183		6			269		
Prop LTs	0.000			1.000 0.988			1.000			0.108		
Prop RTs	0.000			0.000						0.004		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.999	
fLT	1.000		0.755 0.727		0.579		0.995	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1454 1399		1027		4876	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	542	1454	# 0.37	0.42	606	0.89
Prot							
Perm							
Thru	LT	183	1399	0.13	0.42	583	0.31
Right							
Northbound							
Prot							
Perm							
Left	L	6	1027	0.01	0.42	428	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	269	4876	# 0.06	0.42	2032	0.13
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.43
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.89	0.42	16.3	1.000	606	0.50	17.8	0.0	34.0	C		
LT	0.31	0.42	11.7	1.000	583	0.50	1.4	0.0	13.1	B	28.8	C
Northbound												
L	0.01	0.42	10.3	1.000	428	0.50	0.1	0.0	10.3	B	10.3	B
Southbound												
LTR	0.13	0.42	10.8	1.000	2032	0.50	0.1	0.0	10.9	B	10.9	B

Intersection delay = 23.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		542	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.11	
Adjusted opposing flow rate, Vo (veh/h)		4	269	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		9.03	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	1.65	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	25.00	
n=Max(gq-gf)/2,0)		0.00	0.00	
PTHo=1-PLTo		1.00	0.89	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	1.73	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.58	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.579	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	180		
Proportion of LT in LT lane group, PLT	0.000	0.988	0.108
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.00		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.727		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		542	183	6		98	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1454	1399	1027		1790	
LnCapacity	784		606	583	428		745	
Flow Ratio	0.0		0.4	0.1	0.0		0.1	
v/c Ratio	0.01		0.89	0.31	0.01		0.13	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.971		0.951	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		8.4	2.0	0.1		1.0	
kB	0.7		0.6	0.6	0.5		0.7	
Q2	0.0		3.5	0.3	0.0		0.1	
Q Average	0.0		11.9	2.3	0.1		1.1	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.3	
BOQ	0.1		14.4	2.9	0.1		1.4	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7		1.6	
BOQ	0.1		17.0	3.7	0.1		1.8	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0		1.9	
BOQ	0.1		18.4	4.2	0.1		2.1	
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	2.2	2.6		2.4	
BOQ	0.1		20.1	5.1	0.2		2.7	
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2		2.9	
BOQ	0.1		21.8	6.1	0.2		3.2	
QSRatio								

ERROR MESSAGES

No errors to report.

Vehicle Volumes and Adjustments

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			432			
Peak Hour Factor, PHF			0.88			
Hourly Flow Rate, HFR			490			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
Lanes			1			
Configuration			R			

v (vph)		490
C(m) (vph)		1038
v/c		0.47
95% queue length		2.58
Control Delay		11.5
LOS		B
Approach Delay	11.5	
Approach LOS	B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12-1
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 27
 Peak-Hour Factor, PHF 0.69
 Peak-15 Minute Volume 10
 Hourly Flow Rate, HFR 39
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 432
 Peak Hour Factor, PHF 0.88
 Peak-15 Minute Volume 123
 Hourly Flow Rate, HFR 490
 Percent Heavy Vehicles 0
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					39			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	39	
Potential Capacity	1038	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1038	
Probability of Queue free St.	0.53	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.53
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.53
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			490			
Movement Capacity (vph)			1038			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1038			
Volume			490			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					490			
C(m) (vph)					1038			
v/c					0.47			
95% queue length					2.58			
Control Delay					11.5			
LOS					B			
Approach Delay				11.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/04/2011
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	67	33	96	49	0	0	0	0	16	111	21
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT	TR
PHF	0.75		0.85				0.89	0.89
Flow Rate	133		169				78	85
% Heavy Veh	2		4				0	0
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	133		169				78	85
Left-Turn	0		112				17	0
Right-Turn	44		0				0	23
Prop. Left-Turns	0.0		0.7				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: AS
Agency/Co.: Philip Habib & Associates
Date Performed: 8/04/2011
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2011 Existing Conditions
Project ID: 1121A - Charleston
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24	59	0	0	96	22	49	99	102	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	110		137		102		159	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	110		137		102	159		
Left-Turn	32		0		51	0		
Right-Turn	0		25		0	107		
Prop. Left-Turns	0.3		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.2		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Englewood Ave @ Vets Rd E
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	175	152	132	0	59	14	601	61	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	534	1527	0.82	0.35	30.7	C	27.9	C
R	560	1599	0.16	0.35	14.0	B		

Westbound

LTR	557	1592	0.16	0.35	14.0	B	14.0	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2267	4690	0.32	0.48	9.8	A	9.8	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 17.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	175	152	132	0	59	14	601	61	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	58	51	44	0	18	4	162	16	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		436	88		88			715				
%InSharedLn												
Prop LTs		0.534			0.000			0.903				
Prop RTs		0.000	1.000		0.193			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0						29.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	175	152	132	0	59	14	601	61	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	233	203	88	0	71	17	646	66	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		436	88		88			715				
Prop LTs		0.534			0.000			0.903				
Prop RTs		0.000	1.000		0.193			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.974			0.999	
fLT	0.786			1.000			0.957	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1527	1599		1592			4690	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 17.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	233	0	
Proportion of LT in LT lane group, PLT	0.534	0.000	0.903
Proportion of LT in opposing flow, PLTo	0.00	0.53	
Adjusted opposing flow rate, Vo (veh/h)	88	436	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.88	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.47	7.27	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	9.18	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	11.82	
n=Max(gq-gf)/2,0)	0.00	4.59	
PTHo=1-PLTo	1.00	0.47	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.53	0.00	
EL1 (refer to Exhibit C16-3)	1.51	2.16	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.82	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.10	
gdifff=max(gq-gf,0)	0.00	9.18	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.79	0.56	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.786	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	9.18		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.437		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	88	436	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.534	0.000	0.903	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.193	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	17.7	0.00	0.0	0.0	30.7
R	0.0	0.00	19.5	13.4	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.4	0.00	0.0	0.0	14.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.4	0.00	0.0	0.0	9.8
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			17.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	436	88	88	262			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1527	1599	1592	1721			
LnCapacity	534	560	557	832			
Flow Ratio	0.3	0.1	0.1	0.2			
v/c Ratio	0.82	0.16	0.16	0.31			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.997		0.993	0.967			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	6.6	1.0	1.0	2.7			
kB	0.6	0.6	0.6	0.7			
Q2	2.1	0.1	0.1	0.3			
Q Average	8.7	1.1	1.1	3.0			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	10.6	1.4	1.4	3.8			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.6	1.6	1.6			
BOQ	12.7	1.8	1.8	4.7			
QSRatio							
90th Percentile Output:							
fB%	1.6	1.9	1.9	1.8			
BOQ	13.8	2.1	2.1	5.3			
QSRatio							
95th Percentile Output:							
fB%	1.8	2.4	2.4	2.1			
BOQ	15.5	2.7	2.7	6.4			
QSRatio							
98th Percentile Output:							
fB%	2.0	2.9	2.9	2.5			
BOQ	17.1	3.2	3.2	7.6			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Englewood Av & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Volume	103		52				16	366			344	57
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 459 1723 0.37 0.27 20.0+ C 20.0+ C

Westbound

Northbound

LT 1113 1964 0.37 0.57 8.0 A 8.0 A

Southbound

TR 1185 2091 0.37 0.57 8.0 A 8.0 A

Intersection Delay = 10.0- (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	103		52				16	366		344	57	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
PK 15 Vol	28		14				4	99		95	16	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		169						415			441	
%InSharedLn												
Prop LTs		0.663						0.041			0.000	
Prop RTs		0.337						0.000			0.143	
Peds Bikes	0			0						0		0
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.937						0.937			0.937	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	103		52				16	366		344	57	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
Adj flow	112		57				17	398		378	63	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		169						415			441	
Prop LTs		0.663						0.041			0.000	
Prop RTs		0.337						0.000			0.143	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.954						1.000			0.981		
fLT	0.968						0.979			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1723						1964			2091		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	169	1723	# 0.10	0.27	459	0.37
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	415	1964	# 0.21	0.57	1113	0.37
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	441	2091	0.21	0.57	1185	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.37

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.37	0.27	17.9	1.000	459	0.50	2.1	0.0	20.0+	C	20.0+	C
Westbound												
Northbound												
LT	0.37	0.57	7.1	1.000	1113	0.50	0.9	0.0	8.0	A	8.0	A
Southbound												
TR	0.37	0.57	7.1	1.000	1185	0.50	0.8	0.0	8.0	A	8.0	A

Intersection delay = 10.0- (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		17	
Proportion of LT in LT lane group, PLT	0.663	0.041	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		441	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.28	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.35	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		4.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.96	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.17	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdif=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.979	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.31	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.127	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			441	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.041	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.143
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	17.9	0.00	0.0	0.0	20.0+
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.1	0.00	0.0	0.0	8.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.1	0.00	0.0	0.0	8.0
	0.0						0.0	

Intersection Delay	10.0-	sec/veh	Intersection LOS	A
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	169						415			441		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1723						1964			2091		
LnCapacity	459						1113			1185		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.37						0.37			0.37		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.937						0.937			0.937		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.3						3.8			4.0		
kB	0.5						0.9			0.9		
Q2	0.3						0.5			0.5		
Q Average	2.6						4.3			4.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	3.2						5.4			5.7		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	4.0						6.6			6.9		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.7			1.7		
BOQ	4.6						7.4			7.8		
QSRatio												
95th Percentile Output:												
fB%	2.2						2.0			2.0		
BOQ	5.6						8.7			9.1		
QSRatio												
98th Percentile Output:												
fB%	2.6						2.3			2.3		
BOQ	6.7						10.1			10.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Sharrotts Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	99		62				40	369		348	78	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								20	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 572 1716 0.38 0.33 17.0 B 17.0 B

Westbound

Northbound

LT 869 1738 0.51 0.50 11.9 B 11.9 B

Southbound

TR 1046 2091 0.43 0.50 10.7 B 10.7 B

Intersection Delay = 12.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	99		62				40	369		348	78	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	33		21				11	100		96	21	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		215						444			446	
%InSharedLn												
Prop LTs		0.614						0.097			0.000	
Prop RTs		0.386						0.000			0.143	
Peds Bikes	0	0		0						0	0	
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	99		62				40	369		348	78	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	132		83				43	401		382	64	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		215						444			446	
Prop LTs		0.614						0.097			0.000	
Prop RTs		0.386						0.000			0.143	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.948						1.000			0.981		
fLT	0.970						0.931			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1716						1738			2091		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	215	1716	# 0.13	0.33	572	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	444	1738	# 0.26	0.50	869	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	446	2091	0.21	0.50	1046	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.38	0.33	15.2	1.000	572	0.50	1.8	0.0	17.0	B	17.0	B
Westbound												
Northbound												
LT	0.51	0.50	10.1	1.000	869	0.50	1.8	0.0	11.9	B	11.9	B
Southbound												
TR	0.43	0.50	9.5	1.000	1046	0.50	1.2	0.0	10.7	B	10.7	B

Intersection delay = 12.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		43	
Proportion of LT in LT lane group, PLT	0.614	0.097	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		446	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.72	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.43	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		5.93	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.06	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.10	
EL1 (refer to Exhibit C16-3)		2.18	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.93	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.931	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			5.93	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.198	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		446	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.614		0.097	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.386	0.143
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	15.2	0.00	0.0	0.0 0.0 0.0	17.0
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	10.1	0.00	0.0	0.0 0.0 0.0	11.9
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	9.5	0.00	0.0	0.0 0.0 0.0	10.7
Intersection Delay			12.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	215						444			446		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1716						1738			2091		
LnCapacity	572						869			1046		
Flow Ratio	0.1						0.3			0.2		
v/c Ratio	0.38						0.51			0.43		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.7						5.0			4.7		
kB	0.5						0.7			0.8		
Q2	0.3						0.7			0.6		
Q Average	3.1						5.7			5.3		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	3.8						7.0			6.6		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	4.8						8.5			8.0		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.7			1.7		
BOQ	5.4						9.4			8.9		
QSRatio												
95th Percentile Output:												
fB%	2.1						1.9			1.9		
BOQ	6.5						10.9			10.3		
QSRatio												
98th Percentile Output:												
fB%	2.5						2.2			2.2		
BOQ	7.7						12.3			11.8		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Vets Rd E & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	18		114	258	573	161	76	203		380		16
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.11	0.13	23.6	C	37.2	D
R	220	1652	0.73	0.13	39.3	D		
Westbound								
LTR	1338	4724	0.85	0.28	23.9	C	23.9	C
Northbound								
L	163	488	0.51	0.33	26.1	C		
T	621	1863	0.36	0.33	16.6	B	19.2	B
Southbound								
TR	707	2120	0.62	0.33	19.9	B	19.9	B

Intersection Delay = 23.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	18		114	258	573	161	76	203		380	16	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	6		40	74	165	46	21	55		106	4	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	25		161		1141		83	221			440	
%InSharedLn												
Prop LTs					0.260		1.000	0.000			0.000	
Prop RTs			1.000		0.162			0.000			0.041	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	18		114	258	573	161	76	203		380	16	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	25		161	297	659	185	83	221		422	18	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	25		161		1141		83	221			440	
Prop LTs					0.260		1.000	0.000			0.000	
Prop RTs			1.000		0.162			0.000			0.041	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.980	0.980	0.990	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	1.000	1.000	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.976			1.000	0.994	
fLT	0.950		0.987		0.262	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4724		488	1863	2120	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	25	1668	0.01	0.13	222	0.11
Prot							
Perm							
Thru							
Right	R	161	1652	# 0.10	0.13	220	0.73
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1141	4724	# 0.24	0.28	1338	0.85
Right							
Northbound							
Prot							
Perm							
Left	L	83	488	0.17	0.33	163	0.51
Prot							
Perm							
Thru	T	221	1863	0.12	0.33	621	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	440	2120	# 0.21	0.33	707	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.11	0.13	22.9	1.000	222	0.50	0.7	0.0	23.6	C	37.2	D	
R	0.73	0.13	25.0	1.000	220	0.50	14.3	0.0	39.3	D			
Westbound													
LTR	0.85	0.28	20.3	1.000	1338	0.50	3.6	0.0	23.9	C	23.9	C	
Northbound													
L	0.51	0.33	16.1	1.000	163	0.50	10.0	0.0	26.1	C	19.2	B	
T	0.36	0.33	15.1	1.000	621	0.50	1.5	0.0	16.6	B			
Southbound													
TR	0.62	0.33	16.8	1.000	707	0.50	3.1	0.0	19.9	B	19.9	B	

Intersection delay = 23.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			83	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			440	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.38	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.33	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			9.67	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			10.33	
n=Max(gq-gf)/2,0)			4.84	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.97	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.26	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.262	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.260 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.67	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.484	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			440	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.162	0.041
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.6
	0.0						0.0	
R	0.0	0.00	26.0	25.0	0.00	0.0	0.0	39.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.3	0.00	0.0	0.0	23.9
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.1	0.00	0.0	0.0	26.1
T	0.0	0.00	20.0	15.1	0.00	0.0	0.0	16.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.8	0.00	0.0	0.0	19.9
	0.0						0.0	
Intersection Delay			23.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	25	161		418		83	221		440
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1734		488	1863		2120
LnCapacity	222	220		491		163	621		707
Flow Ratio	0.0	0.1		0.2		0.2	0.1		0.2
v/c Ratio	0.11	0.73		0.85		0.51	0.36		0.62
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.717		0.483			0.917		0.747
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.4	2.6		6.6		1.1	2.8		6.2
kB	0.2	0.2		0.3		0.2	0.6		0.5
Q2	0.0	0.5		1.3		0.2	0.3		0.8
Q Average	0.4	3.1		7.8		1.3	3.1		7.0
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.5	3.9		9.6		1.7	3.9		8.5
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.5
BOQ	0.7	4.9		11.5		2.2	4.8		10.3
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.8	5.5		12.6		2.5	5.5		11.3
QSRatio									
95th Percentile Output:									
fB%	2.5	2.1		1.8		2.4	2.1		1.8
BOQ	1.0	6.7		14.2		3.2	6.6		12.9
QSRatio									
98th Percentile Output:									
fB%	3.1	2.5		2.0		2.8	2.5		2.1
BOQ	1.2	7.8		15.8		3.8	7.8		14.5
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: S Service Rd & Bloomingdale Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	29	31	5				3	250	137	293	415	44
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.19 0.28 17.2 B 17.2 B

Westbound

Northbound

LTR 966 1756 0.44 0.55 9.3 A 9.3 A

Southbound

L 525 954 0.62 0.55 12.8 B
 TR 1023 1860 0.49 0.55 9.4 A 10.7 B

Intersection Delay = 10.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	29	31	5				3	250	137	293	415	44
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	10	2				1	68	37	81	115	12
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		86						424		326	498	
%InSharedLn												
Prop LTs		0.442						0.007		1.000	0.000	
Prop RTs		0.081						0.351			0.074	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	29	31	5				3	250	137	293	415	44
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	38	41	7				3	272	149	326	461	37
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	86						424			326	498	
Prop LTs	0.442						0.007			1.000	0.000	
Prop RTs	0.081						0.351			0.074		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.990	0.990	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							1.000			1.000	1.000	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.989							0.953				0.989	
fLT	0.978							0.998			0.507	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1630							1756			954	1860	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	86	1630	# 0.05	0.28	462	0.19
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	424	1756	0.24	0.55	966	0.44
Right							
Southbound							
Prot							
Perm							
Left	L	326	954	# 0.34	0.55	525	0.62
Prot							
Perm							
Thru	TR	498	1860	0.27	0.55	1023	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.19	0.28	16.3	1.000	462	0.50	0.9	0.0	17.2	B	17.2	B
Westbound												
Northbound												
LTR	0.44	0.55	8.0	1.000	966	0.50	1.3	0.0	9.3	A	9.3	A
Southbound												
L	0.62	0.55	9.2	1.000	525	0.50	3.5	0.0	12.8	B		
TR	0.49	0.55	8.3	1.000	1023	0.50	1.1	0.0	9.4	A	10.7	B

Intersection delay = 10.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				326
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				424
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.43
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.07
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.40
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.60
n=Max(gq-gf)/2,0)				2.20
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.19
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				4.40
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.51
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.507

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.442
Proportion of LT in opposing flow, PLTo	0.007 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	498
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	5.63
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			5.63	4.40
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.170	0.133
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			498	424
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.007	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.081	0.351	0.074
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.0	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.2	0.00	0.0	0.0	12.8
TR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	9.4
	0.0						0.0	

Intersection Delay	10.7	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	86						424			326	498	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1630						1756			954	1860	
LnCapacity	462						966			525	1023	
Flow Ratio	0.1						0.2			0.3	0.3	
v/c Ratio	0.19						0.44			0.62	0.49	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.899				0.644	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	1.1						4.2			3.7	5.1	
kB	0.5						0.8			0.4	0.6	
Q2	0.1						0.6			0.6	0.5	
Q Average	1.2						4.8			4.3	5.6	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	1.5						5.9			5.3	6.9	
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5	1.5	
BOQ	2.0						7.2			6.5	8.4	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7	1.7	
BOQ	2.3						8.1			7.3	9.4	
QSRatio												
95th Percentile Output:												
fB%	2.4						2.0			2.0	1.9	
BOQ	2.9						9.5			8.7	10.8	
QSRatio												
98th Percentile Output:												
fB%	2.9						2.3			2.3	2.2	
BOQ	3.5						10.9			10.0	12.3	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Amboy Rd & Bloomingdale Ave
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	7	7	17	273	17	98	12	245	225	80	327	7
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 630 1417 0.06 0.44 14.4 B 14.4 B

Westbound

L 581 1307 0.52 0.44 21.0 C
 T 808 1818 0.02 0.44 14.1 B 19.4 B
 R 601 1352 0.18 0.44 15.7 B

Northbound

LTR 735 1653 0.71 0.44 23.4 C 23.4 C

Southbound

LTR 642 1445 0.72 0.44 23.8 C 23.8 C

Intersection Delay = 22.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
 Agency/Co.: Philip Habib & Associates
 Date Performed: 8/04/2011
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	7	17	273	17	98	12	245	225	80	327	7
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	76	5	27	3	67	61	22	91	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		36		303	19	109		524			460	
%InSharedLn												
Prop LTs		0.222		1.000	0.000			0.025			0.193	
Prop RTs		0.556			0.000	1.000		0.468			0.017	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	7	17	273	17	98	12	245	225	80	327	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	8	8	20	303	19	109	13	266	245	89	363	8
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	36			303	19	109	524			460		
Prop LTs	0.222			1.000	0.000		0.025			0.193		
Prop RTs	0.556			0.000 1.000			0.468			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.990	0.990	0.990	1.000		0.990		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	1.000		1.000	1.000	1.000	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.925		1.000 0.850			0.937		0.998		
fLT	0.970		0.734	1.000		0.986		0.773		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.996		
fRpb	0.969		1.000 1.000			0.974		1.000		
S	1417		1307	1818	1352	1653		1445		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	36	1417	0.03	0.44	630	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	303	1307	# 0.23	0.44	581	0.52
Prot							
Perm							
Thru	T	19	1818	0.01	0.44	808	0.02
Right	R	109	1352	0.08	0.44	601	0.18
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	524	1653	0.32	0.44	735	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	460	1445	# 0.32	0.44	642	0.72
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	630	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.52	0.44	18.1	1.000	581	0.50	3.0	0.0	21.0	C		
T	0.02	0.44	14.0	1.000	808	0.50	0.0	0.0	14.1	B	19.4	B
R	0.18	0.44	15.1	1.000	601	0.50	0.6	0.0	15.7	B		
Northbound												
LTR	0.71	0.44	20.3	1.000	735	0.50	3.1	0.0	23.4	C	23.4	C
Southbound												
LTR	0.72	0.44	20.4	1.000	642	0.50	3.4	0.0	23.8	C	23.8	C

Intersection delay = 22.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		303		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.22		
Adjusted opposing flow rate, Vo (veh/h)		36		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.58		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.90		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.78		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.734		

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	8	13	89
Proportion of LT in LT lane group, PLT	0.222	0.000	0.025
Proportion of LT in opposing flow, PLTo	0.00	0.19	0.02
Adjusted opposing flow rate, Vo (veh/h)	19	460	524
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.20	0.33	2.23
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.47	11.50	13.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	25.3	21.2	4.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	12.04	13.82
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.71	18.83	26.18
n=Max(gq-gf)/2,0)	0.00	0.00	4.58
PTHo=1-PLTo	1.00	0.81	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.22	0.02	0.19
EL1 (refer to Exhibit C16-3)	1.40	2.21	2.35
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.38
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	9.17
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.99	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.970	0.986	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	12.04	13.82
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.301	0.345
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	19	36	460	524
OCCr	0.000	0.053	0.000	0.022
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.978
Proportion of left turns, PLT	0.222	1.000	0.025	0.193
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.556	1.000	0.468	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.969	1.000	0.974	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.4
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.1	0.00	0.0	0.0	21.0
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.1	0.00	0.0	0.0	15.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.3	0.00	0.0	0.0	23.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.4	0.00	0.0	0.0	23.8
	0.0						0.0	
Intersection Delay			22.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	36		303	19	109	524		460	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1417		1307	1818	1352	1653		1445	
LnCapacity	630		581	808	601	735		642	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.3	
v/c Ratio	0.06		0.52	0.02	0.18	0.71		0.72	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.887			0.516		0.500	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.5		5.5	0.3	1.6	10.7		9.4	
kB	0.8		0.7	0.9	0.7	0.5		0.4	
Q2	0.1		0.7	0.0	0.2	1.1		1.0	
Q Average	0.6		6.2	0.3	1.8	11.8		10.4	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	0.7		7.6	0.4	2.3	14.3		12.6	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	0.9		9.2	0.5	2.9	16.8		14.9	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.5		1.6	
BOQ	1.1		10.2	0.6	3.3	18.2		16.2	
QSRatio									
95th Percentile Output:									
fB%	2.5		1.9	2.5	2.3	1.7		1.7	
BOQ	1.4		11.7	0.7	4.1	20.0		17.9	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.8		1.9	
BOQ	1.7		13.3	0.9	5.0	21.7		19.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: AS Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 8/04/2011 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2011 Existing Conditions
 Project ID: 1121A - Charleston
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	127		223	28	115		141		20			
Lane Width	16.0			16.0			11.0					
RTOR Vol			56					0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR 967 1934 0.39 0.50 15.1 B 15.1 B

Westbound

LT 927 1853 0.17 0.50 12.7 B 12.7 B

Northbound

LR 583 1499 0.33 0.39 20.7 C 20.7 C

Southbound

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: AS
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VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		127	223	28	115		141		20			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		41	71	8	32		41		6			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		377			160			190				
%InSharedLn												
Prop LTs		0.000			0.194			0.874				
Prop RTs		0.568			0.000			0.126				
Peds Bikes	0						0			0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		127	223	28	115		141		20			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		163	214	31	129		166		24			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		377			160			190				
Prop LTs		0.000			0.194			0.874				
Prop RTs		0.568			0.000			0.126				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.923			1.000			0.983					
fLT	1.000			0.895			0.958					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1934			1853			1499					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	377	1934	# 0.19	0.50	967	0.39
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	160	1853	0.09	0.50	927	0.17
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	190	1499	# 0.13	0.39	583	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.39	0.50	14.0	1.000	967	0.50	1.1	0.0	15.1	B	15.1	B
Westbound												
LT	0.17	0.50	12.3	1.000	927	0.50	0.4	0.0	12.7	B	12.7	B
Northbound												
LR	0.33	0.39	19.2	1.000	583	0.50	1.4	0.0	20.7	C	20.7	C
Southbound												

Intersection delay = 16.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	31		
Proportion of LT in LT lane group, PLT	0.000	0.194	0.874
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	377		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	0.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.43		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.6		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	8.09		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.37		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.19		
EL1 (refer to Exhibit C16-3)	2.03		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.89		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.895		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.0	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	12.3	0.00	0.0	0.0	12.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	19.2	0.00	0.0	0.0	20.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			16.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		377			160			190				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1934			1853			1499				
LnCapacity		967			927			583				
Flow Ratio		0.2			0.1			0.1				
v/c Ratio		0.39			0.17			0.33				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.9			2.2			3.3				
kB		1.0			1.1			0.7				
Q2		0.7			0.2			0.4				
Q Average		6.5			2.4			3.7				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.3			1.2				
BOQ		8.0			3.0			4.6				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.6			1.5				
BOQ		9.6			3.8			5.7				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.8			1.7				
BOQ		10.6			4.4			6.4				
QSRatio												
95th Percentile Output:												
fB%		1.9			2.2			2.1				
BOQ		12.2			5.3			7.7				
QSRatio												
98th Percentile Output:												
fB%		2.1			2.6			2.4				
BOQ		13.7			6.3			8.9				
QSRatio												

ERROR MESSAGES

No errors to report.

No-Action

2015

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	8	7	7	60	9	27	26	138	41	28	138	37
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 179 1533 0.16 0.12 25.7 C 25.7 C

Westbound

LTR 478 1913 0.21 0.25 18.8 B 18.8 B

Northbound

LTR 620 1618 0.40 0.38 15.4 B 15.4 B

Southbound

LTR 655 1709 0.37 0.38 15.0 B 15.0 B

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	7	7	60	9	27	26	138	41	28	138	37
% Heavy Veh	32	32	32	5	5	5	20	20	20	13	13	13
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	3	2	2	16	3	7	8	42	12	8	42	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			100			246			245	
%InSharedLn												
Prop LTs		0.357			0.630			0.126			0.139	
Prop RTs		0.321			0.280			0.199			0.184	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			4			4	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	7	7	60	9	27	26	138	41	28	138	37
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	10	9	9	63	9	28	31	166	49	34	166	45
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	28			100			246			245		
Prop LTs	0.357			0.630			0.126			0.139		
Prop RTs	0.321			0.280			0.199			0.184		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.758			0.952			0.833			0.885		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.984			0.984		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.957			0.962			0.973			0.975		
fLT	0.982			0.969			0.942			0.935		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1533			1913			1618			1709		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1533	# 0.02	0.12	179	0.16
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	100	1913	# 0.05	0.25	478	0.21
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	246	1618	# 0.15	0.38	620	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	245	1709	0.14	0.38	655	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.22
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.30

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.16	0.12	23.8	1.000	179	0.50	1.9	0.0	25.7	C	25.7	C
Westbound												
LTR	0.21	0.25	17.8	1.000	478	0.50	1.0	0.0	18.8	B	18.8	B
Northbound												
LTR	0.40	0.38	13.5	1.000	620	0.50	1.9	0.0	15.4	B	15.4	B
Southbound												
LTR	0.37	0.38	13.3	1.000	655	0.50	1.6	0.0	15.0	B	15.0	B

Intersection delay = 16.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			31	34
Proportion of LT in LT lane group, PLT	0.357	0.630	0.126	0.139
Proportion of LT in opposing flow, PLTo			0.14	0.13
Adjusted opposing flow rate, Vo (veh/h)			245	246
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.52	0.57
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.08	4.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			8.0	7.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			3.65	3.67
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.96	15.40
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.86	0.87
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.13	0.14
EL1 (refer to Exhibit C16-3)			1.78	1.78
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.942	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				3.67
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.160
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				246
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.139
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.321	0.199
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	23.8	0.00	0.0	0.0	25.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.8	0.00	0.0	0.0	18.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.5	0.00	0.0	0.0	15.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.3	0.00	0.0	0.0	15.0
	0.0						0.0	
Intersection Delay			16.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			LTR			LTR			LTR		
Init Queue	0.0			0.0			0.0			0.0		
Flow Rate	28			100			246			245		
So	1900			1900			1900			1900		
No.Lanes	0	1	0	0	1	0	0	1	0	0	1	0
SL	1533			1913			1618			1709		
LnCapacity	179			478			620			655		
Flow Ratio	0.0			0.1			0.2			0.1		
v/c Ratio	0.16			0.21			0.40			0.37		
Grn Ratio	0.12			0.25			0.38			0.38		
I Factor	1.000			1.000			1.000			1.000		
AT or PVG	3			3			3			3		
Pltn Ratio	1.00			1.00			1.00			1.00		
PF2	1.00			1.00			1.00			1.00		
Q1	0.4			1.3			3.0			2.9		
kB	0.3			0.5			0.6			0.6		
Q2	0.0			0.1			0.4			0.4		
Q Average	0.5			1.5			3.4			3.3		
Q Spacing	25.0			25.0			25.0			25.0		
Q Storage	0			0			0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.3			1.3			1.3		
BOQ	0.6			1.9			4.2			4.2		
QSRatio												
85th Percentile Output:												
fB%	1.7			1.6			1.6			1.6		
BOQ	0.8			2.4			5.3			5.2		
QSRatio												
90th Percentile Output:												
fB%	2.0			1.9			1.8			1.8		
BOQ	0.9			2.7			5.9			5.8		
QSRatio												
95th Percentile Output:												
fB%	2.5			2.3			2.1			2.1		
BOQ	1.2			3.4			7.1			7.0		
QSRatio												
98th Percentile Output:												
fB%	3.1			2.8			2.5			2.5		
BOQ	1.4			4.1			8.3			8.2		
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			189	31		20	186	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			227	37		24	224	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		7		16				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		10		23				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10
Lane Config		LT			LR			
v (vph)		24			33			
C(m) (vph)		1250			682			
v/c		0.02			0.05			
95% queue length		0.06			0.15			
Control Delay		7.9			10.5			
LOS		A			B			
Approach Delay					10.5			
Approach LOS					B			

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		189	31	20	186	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		57	9	6	56	
Hourly Flow Rate, HFR		227	37	24	224	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	7		16			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	10		23			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		224
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		264	518		246			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	246	
Potential Capacity	798	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	798	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	264	
Potential Capacity	1250	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1250	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	518	
Potential Capacity	521	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.95
Movement Capacity	511	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 518
Potential Capacity 521
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.95
Movement Capacity 511

Results for Two-stage process:
a
y
C t 511

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		23			
Movement Capacity (vph)	511		798			
Shared Lane Capacity (vph)		682				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	511		798			
Volume	10		23			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		682				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		24		33				
C(m) (vph)		1250		682				
v/c		0.02		0.05				
95% queue length		0.06		0.15				
Control Delay		7.9		10.5				
LOS		A		B				
Approach Delay				10.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		224
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		7.9
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	256	33	257	0	139	273	73	112	8
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	710	1705	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	531	1275	0.63	0.42	19.0	B	18.4	B
R	514	1233	0.57	0.42	17.8	B		

Northbound

LTR	703	1687	0.69	0.42	19.2	B	19.2	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	465	1117	0.48	0.42	16.2	B	16.2	B
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 18.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	256	33	257	0	139	273	73	112	8
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	74	9	74	0	41	80	21	32	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			332	295		485			222	
%InSharedLn												
Prop LTs		0.273			0.886			0.000			0.378	
Prop RTs		0.091			0.000	1.000		0.662			0.041	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	256	33	257	0	139	273	73	112	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	294	38	295	0	164	321	84	129	9
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			332 295			485			222		
Prop LTs	0.273			0.886			0.000			0.378		
Prop RTs	0.091			0.000 1.000			0.662			0.041		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.911			0.995		
fLT	0.939			0.743			1.000			0.586		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1705			1275 1233			1687			1117		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1705	0.01	0.42	710	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	332	1275	# 0.26	0.42	531	0.63
Right	R	295	1233	0.24	0.42	514	0.57
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	485	1687	# 0.29	0.42	703	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	222	1117	0.20	0.42	465	0.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	710	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.63	0.42	13.8	1.000	531	0.50	5.2	0.0	19.0	B	18.4	B
R	0.57	0.42	13.4	1.000	514	0.50	4.3	0.0	17.8	B		
Northbound												
LTR	0.69	0.42	14.3	1.000	703	0.50	4.9	0.0	19.2	B	19.2	B
Southbound												
LTR	0.48	0.42	12.7	1.000	465	0.50	3.5	0.0	16.2	B	16.2	B

Intersection delay = 18.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	294	0	84
Proportion of LT in LT lane group, PLT	0.273	0.886	0.000	0.378
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.38	0.00
Adjusted opposing flow rate, Vo (veh/h)	332	11	222	485
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	4.90	0.00	1.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.53	0.18	3.70	8.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	3.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.28	0.00	2.56	8.72
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	22.44	16.28
n=Max(gq-gf)/2,0)	0.00	0.00	1.28	2.54
PTHo=1-PLTo	0.11	0.73	0.62	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.38
EL1 (refer to Exhibit C16-3)	1.94	1.39	1.74	2.27
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.21	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	2.56	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.939	0.743	1.000	0.586

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.28			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.211			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	332			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.8	0.00	0.0	0.0	19.0
R	0.0	0.00	17.5	13.4	0.00	0.0	0.0	17.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.3	0.00	0.0	0.0	19.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	12.7	0.00	0.0	0.0	16.2
	0.0						0.0	
Intersection Delay			18.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	11			332	295	485		222	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1705			1275	1233	1687		1117	
LnCapacity	710			531	514	703		465	
Flow Ratio	0.0			0.3	0.2	0.3		0.2	
v/c Ratio	0.02			0.63	0.57	0.69		0.48	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.940		0.887		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.1			4.4	3.8	6.6		2.7	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			0.8	0.7	1.3		0.5	
Q Average	0.1			5.2	4.4	7.9		3.1	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.3	
BOQ	0.2			6.4	5.5	9.6		3.9	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.5	1.5	1.5		1.6	
BOQ	0.2			7.8	6.8	11.5		4.9	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.7	1.7	1.6		1.8	
BOQ	0.2			8.7	7.6	12.6		5.6	
QSRatio									
95th Percentile Output:									
fB%	2.6			2.0	2.0	1.8		2.1	
BOQ	0.3			10.2	8.9	14.2		6.7	
QSRatio									
98th Percentile Output:									
fB%	3.2			2.2	2.3	2.0		2.5	
BOQ	0.4			11.6	10.3	15.8		7.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				156		5	408			369		
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 631 1893 0.29 0.33 15.8 B 15.8 B

Northbound

T 970 1940 0.49 0.50 11.6 B 11.6 B

Southbound

T 925 1850 0.46 0.50 11.0 B 11.0 B

Intersection Delay = 12.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				156		5	408			369		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				44		2	120			106		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					183		480			424		
%InSharedLn												
Prop LTs					0.967		0.000			0.000		
Prop RTs					0.033		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				156		5	408			369		
PHF				0.88		0.88	0.85			0.87		
Adj flow				177		6	480			424		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					183			480			424	
Prop LTs					0.967			0.000			0.000	
Prop RTs					0.033			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.996			1.000			1.000	
fLT					0.954			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1893			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	183	1893	# 0.10	0.33	631	0.29
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	480	1940	# 0.25	0.50	970	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	424	1850	0.23	0.50	925	0.46
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.34
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.29	0.33	14.8	1.000	631	0.50	1.0	0.0	15.8	B	15.8	B
Northbound												
T	0.49	0.50	10.0	1.000	970	0.50	1.6	0.0	11.6	B	11.6	B
Southbound												
T	0.46	0.50	9.7	1.000	925	0.50	1.2	0.0	11.0	B	11.0	B

Intersection delay = 12.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.967 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	15.8
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.0	0.00	0.0	0.0	11.6
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.7	0.00	0.0	0.0	11.0
	0.0						0.0	
Intersection Delay			12.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: So Bridge St & Arthur Kill Rd
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: South Bridge Street
North/South Street: Arthur Kill Road
Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		408	216	116	409	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		120	64	33	118	
Hourly Flow Rate, HFR		479	254	133	470	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		470
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		733						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	733	
Potential Capacity	795	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	795	
Probability of Queue free St.	0.83	1.00
Maj L-Shared Prob Q free St.	0.77	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.77	0.77
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.83	0.83
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		133						
C(m) (vph)		795						
v/c		0.17						
95% queue length		0.60						
Control Delay		10.4						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.83
v(i1), Volume for stream 2 or 5		470
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.77
d(M,LT), Delay for stream 1 or 4		10.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.4

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				58		136	486	72		89	313	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 384 1440 0.54 0.27 24.2 C 24.2 C

Northbound

TR 1031 1820 0.64 0.57 11.1 B 11.1 B

Southbound

LT 773 1364 0.60 0.57 11.4 B 11.4 B

Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				58		136	486	72		89	313	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				16		37	143	21		26	90	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					208			657			462	
%InSharedLn												
Prop LTs					0.298			0.000			0.221	
Prop RTs					0.702			0.129			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				58		136	486	72		89	313	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				62		146	572	85		102	360	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					208			657			462	
Prop LTs					0.298			0.000			0.221	
Prop RTs					0.702			0.129			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.901			0.917	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.905			0.983			1.000	
fLT					0.985			1.000			0.720	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1440			1820			1364	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	208	1440	# 0.14	0.27	384	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	657	1820	# 0.36	0.57	1031	0.64
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	462	1364	0.34	0.57	773	0.60
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.54	0.27	18.9	1.000	384	0.50	5.3	0.0	24.2	C	24.2	C
Northbound												
TR	0.64	0.57	8.8	1.000	1031	0.50	2.3	0.0	11.1	B	11.1	B
Southbound												
LT	0.60	0.57	8.5	1.000	773	0.50	2.9	0.0	11.4	B	11.4	B

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			102
Proportion of LT in LT lane group, PLT	0.298	0.000	0.221
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			657
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			5.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.61
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.39
n=Max(gq-gf)/2,0)			1.19
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.22
EL1 (refer to Exhibit C16-3)			2.68
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.720

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.61
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.224
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				657
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.221
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.702	0.129
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.9	0.00	0.0	0.0	24.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.8	0.00	0.0	0.0	11.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	8.5	0.00	0.0	0.0	11.4
	0.0						0.0	
Intersection Delay			13.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR		LT
Init Queue					0.0		0.0		0.0
Flow Rate					208		657		462
So					1900		1900		1900
No.Lanes	0	0	0	0	0	0	1	0	1
SL					1440		1820		1364
LnCapacity					384		1031		773
Flow Ratio					0.1		0.4		0.3
v/c Ratio					0.54		0.64		0.60
Grn Ratio					0.27		0.57		0.57
I Factor					0.980		0.769		0.842
AT or PVG					3		3		3
Pltn Ratio					1.00		1.00		1.00
PF2					1.00		1.00		1.00
Q1					3.0		7.4		5.0
kB					0.4		0.7		0.6
Q2					0.5		1.2		0.9
Q Average					3.5		8.6		5.9
Q Spacing					25.0		25.0		25.0
Q Storage					0		0		0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2		1.2
BOQ					4.3		10.5		7.3
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5		1.5
BOQ					5.4		12.5		8.8
QSRatio									
90th Percentile Output:									
fB%					1.7		1.6		1.7
BOQ					6.1		13.6		9.8
QSRatio									
95th Percentile Output:									
fB%					2.1		1.8		1.9
BOQ					7.3		15.3		11.3
QSRatio									
98th Percentile Output:									
fB%					2.4		2.0		2.2
BOQ					8.5		16.9		12.8
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	69	25	65	21	124	24	55	638	108	55	348	28
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	563	1635	0.31	0.34	22.9	C	22.9	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	584	1695	0.31	0.34	23.0	C	23.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	419	770	0.14	0.54	10.6	B		
TR	1048	1925	0.77	0.54	19.8	B	19.2	B

Southbound

LTR	1046	1921	0.48	0.54	14.2	B	14.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	69	25	65	21	124	24	55	638	108	55	348	28
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	19	7	18	6	33	6	15	173	29	16	104	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		177			180		60	810			505	
%InSharedLn												
Prop LTs		0.435			0.122		1.000	0.000			0.129	
Prop RTs		0.407			0.144			0.144			0.051	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	69	25	65	21	124	24	55	638	108	55	348	28
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	77	28	72	22	132	26	60	693	117	65	414	26
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	177			180			60 810			505		
Prop LTs	0.435			0.122			1.000 0.000			0.129		
Prop RTs	0.407			0.144			0.144			0.051		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.945			0.980			0.978			0.992		
fLT	0.812			0.955			0.447 1.000			0.655		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1635			1695			770 1925			1921		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	177	1635	# 0.11	0.34	563	0.31
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	180	1695	0.11	0.34	584	0.31
Right							
Northbound							
Prot							
Perm							
Left	L	60	770	0.08	0.54	419	0.14
Prot							
Perm							
Thru	TR	810	1925	# 0.42	0.54	1048	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	505	1921	0.26	0.54	1046	0.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.31	0.34	21.7	1.000	563	0.50	1.2	0.0	22.9	C	22.9	C
Westbound												
LTR	0.31	0.34	21.6	1.000	584	0.50	1.4	0.0	23.0	C	23.0	C
Northbound												
L	0.14	0.54	10.1	1.000	419	0.50	0.5	0.0	10.6	B		
TR	0.77	0.54	16.1	1.000	1048	0.50	3.7	0.0	19.8	B	19.2	B
Southbound												
LTR	0.48	0.54	12.7	1.000	1046	0.50	1.6	0.0	14.2	B	14.2	B

Intersection delay = 18.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			60	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.13	
Adjusted opposing flow rate, Vo (veh/h)			505	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.50	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.63	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			2.09	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			46.91	
n=Max(gq-gf)/2,0)			1.04	
PTHo=1-PLTo			0.87	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.14	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.04	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			2.09	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.45	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.447	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	77	22	65
Proportion of LT in LT lane group, PLT	0.435	0.122	0.000
Proportion of LT in opposing flow, PLTo	0.12	0.44	0.00
Adjusted opposing flow rate, Vo (veh/h)	180	177	810
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.93	0.55	1.63
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.50	4.43	20.25
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.5	12.2	9.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	4.93	4.81	28.55
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.07	18.82	20.45
n=Max(gq-gf)/2,0)	0.74	0.00	9.75
PTHo=1-PLTo	0.88	0.56	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.44	0.12	0.45
EL1 (refer to Exhibit C16-3)	1.66	1.66	3.11
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	1.47	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.95	0.40
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.812	0.955	0.655

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	4.93	4.81	2.09	28.55
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.159	0.155	0.043	0.583
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	180	177	505	810
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.435	0.122	1.000	0.129
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.407	0.144	0.144	0.051
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.7	0.00	0.0	0.0	22.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.6	0.00	0.0	0.0	23.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.1	0.00	0.0	0.0	10.6
TR	0.0	0.00	20.5	16.1	0.00	0.0	0.0	19.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	12.7	0.00	0.0	0.0	14.2
	0.0						0.0	
Intersection Delay			18.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	177		180		60	810	265	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1635		1695		770	1925	1008	
LnCapacity	563		584		419	1048	549	
Flow Ratio	0.1		0.1		0.1	0.4	0.3	
v/c Ratio	0.31		0.31		0.14	0.77	0.48	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	3.3		3.3		0.7	15.9	4.1	
kB	0.6		0.8		0.4	0.8	0.7	
Q2	0.3		0.3		0.1	2.4	0.7	
Q Average	3.5		3.6		0.8	18.3	4.8	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	4.4		4.6		1.0	22.1	5.9	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.7	1.4	1.5	
BOQ	5.5		5.6		1.3	25.8	7.2	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.7	
BOQ	6.2		6.4		1.6	27.7	8.1	
QSRatio								
95th Percentile Output:								
fB%	2.1		2.1		2.5	1.6	2.0	
BOQ	7.4		7.6		2.0	29.8	9.5	
QSRatio								
98th Percentile Output:								
fB%	2.4		2.4		3.0	1.7	2.3	
BOQ	8.6		8.8		2.4	31.9	10.9	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	275						731			373		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0					50.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.46	0.33	25.8	C	25.8	C

Westbound

Northbound

T 2156 3880 0.37 0.56 11.5 B 11.5 B

Southbound

T 1951 3512 0.23 0.56 10.4 B 10.4 B

Intersection Delay = 14.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	275						731			373		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	76						201			111		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	306						803			444		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	275						731			373		
PHF	0.90						0.91			0.84		
Adj flow	306						803			444		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	306						803			444		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.980						0.990			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2006						3880			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	306	2006	# 0.15	0.33	669	0.46
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	803	3880	# 0.21	0.56	2156	0.37
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	444	3512	0.13	0.56	1951	0.23
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.36
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.46	0.33	23.6	1.000	669	0.50	2.2	0.0	25.8	C	25.8	C	
Westbound													
Northbound													
T	0.37	0.56	11.2	1.000	2156	0.50	0.3	0.0	11.5	B	11.5	B	
Southbound													
T	0.23	0.56	10.2	1.000	1951	0.50	0.3	0.0	10.4	B	10.4	B	

Intersection delay = 14.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.6	0.00	0.0	0.0	25.8
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.2	0.00	0.0	0.0	11.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.2	0.00	0.0	0.0	10.4
	0.0						0.0	
Intersection Delay			14.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	306						421		233	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.2						0.2		0.1	
v/c Ratio	0.46						0.37		0.23	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.0						5.9		3.0	
kB	0.9						0.8		1.1	
Q2	0.7						0.5		0.3	
Q Average	6.7						6.4		3.3	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.3	
BOQ	8.3						7.8		4.1	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.6	
BOQ	10.0						9.5		5.1	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.8	
BOQ	11.0						10.5		5.8	
QSRatio										
95th Percentile Output:										
fB%	1.9						1.9		2.1	
BOQ	12.5						12.0		7.0	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.5	
BOQ	14.1						13.5		8.2	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						373	
Peak-Hour Factor, PHF						0.84	
Hourly Flow Rate, HFR						444	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							57
Peak Hour Factor, PHF							0.70
Hourly Flow Rate, HFR							81
Percent Heavy Vehicles							60
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								81
C(m) (vph)								692
v/c								0.12
95% queue length								0.40
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					373	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					111	
Hourly Flow Rate, HFR					444	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						57
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						20
Hourly Flow Rate, HFR						81
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								222
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		222
Potential Capacity		692
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		692
Probability of Queue free St.	1.00	0.88
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	579
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	579
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	579	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	579	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	651
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	651

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	820	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity	724	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						81
Movement Capacity (vph)						692
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						692
Volume						81
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								81
C(m) (vph)								692
v/c								0.12
95% queue length								0.40
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	48	156	159	196	470	50	85	88	71	4	21	26
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left		P	
	Thru	P				Thru		P	
	Right	P				Right		P	
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		30.0					25.0	20.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	577	0.29	0.33	25.0	C		
TR	580	1740	0.54	0.33	27.3	C	26.9	C
Westbound								
L	231	694	0.97	0.33	81.9	F		
TR	1102	3305	0.54	0.33	26.2	C	41.5	D
Northbound								
LTR	889	3202	0.29	0.28	26.4	C	26.4	C
Southbound								
L	376	1694	0.02	0.22	27.4	C		
TR	351	1578	0.20	0.22	29.7	C	29.6	C

Intersection Delay = 34.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	48	156	159	196	470	50	85	88	71	4	21	26
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	14	44	45	56	135	14	23	24	19	1	8	10
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	55	315		225	593			262		6	70	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.347			0.000	
Prop RTs		0.438			0.089			0.290			0.557	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	48	156	159	196	470	50	85	88	71	4	21	26
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	55	177	138	225	540	53	91	95	76	6	31	39
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	55	315		225	593			262		6	70	
Prop LTs	1.000	0.000		1.000	0.000			0.347			0.000	
Prop RTs		0.438			0.089			0.290			0.557	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.980	0.980		0.926	0.926			0.926		0.971	0.971	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.934			0.987			0.956			0.916	
fLT	0.321	1.000		0.423	1.000			0.983		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	577	1740		694	3305			3202		1694	1578	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	55	577	0.10	0.33	192	0.29
Prot							
Perm							
Thru	TR	315	1740	0.18	0.33	580	0.54
Right							
Westbound							
Prot							
Perm							
Left	L	225	694	# 0.32	0.33	231	0.97
Prot							
Perm							
Thru	TR	593	3305	0.18	0.33	1102	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	262	3202	# 0.08	0.28	889	0.29
Right							
Southbound							
Prot							
Perm							
Left	L	6	1694	0.00	0.22	376	0.02
Prot							
Perm							
Thru	TR	70	1578	# 0.04	0.22	351	0.20
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.45$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.54$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.29	0.33	22.1	1.000	192	0.50	2.9	0.0	25.0	C		
TR	0.54	0.33	24.4	1.000	580	0.50	2.8	0.0	27.3	C	26.9	C
Westbound												
L	0.97	0.33	29.6	1.000	231	0.50	52.3	0.0	81.9	F		
TR	0.54	0.33	24.4	1.000	1102	0.50	1.8	0.0	26.2	C	41.5	D
Northbound												
LTR	0.29	0.28	25.6	1.000	889	0.50	0.8	0.0	26.4	C	26.4	C
Southbound												
L	0.02	0.22	27.3	1.000	376	0.50	0.1	0.0	27.4	C		
TR	0.20	0.22	28.5	1.000	351	0.50	1.3	0.0	29.7	C	29.6	C

Intersection delay = 34.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	55	225		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	593	315		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	1.38	5.63		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.79	7.88		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.55	7.73		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.45	22.27		
n=Max(gq-gf)/2,0)	3.78	3.86		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.33	1.76		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.42		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.321	0.423		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.347 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.55			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.252			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	593			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.089
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	22.1	0.00	0.0	0.0	25.0
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	27.3
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	29.6	0.00	0.0	0.0	81.9
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	25.6	0.00	0.0	0.0	26.4
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	27.3	0.00	0.0	0.0	27.4
TR	0.0	0.00	35.0	28.5	0.00	0.0	0.0	29.7
	0.0						0.0	
Intersection Delay			34.8	sec/veh	Intersection LOS C			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	55	315		225	311		137			6	70	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	577	1740		694	1735		1681			1694	1578	
LnCapacity	192	580		231	578		466			376	351	
Flow Ratio	0.1	0.2		0.3	0.2		0.1			0.0	0.0	
v/c Ratio	0.29	0.54		0.97	0.54		0.29			0.02	0.20	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.0	6.4		5.6	6.3		2.7			0.1	1.4	
kB	0.3	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.1	0.7		3.0	0.9		0.3			0.0	0.1	
Q Average	1.1	7.1		8.6	7.2		3.0			0.1	1.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.3			1.3	1.3	
BOQ	1.4	8.7		10.4	8.8		3.7			0.2	2.0	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.5	1.5		1.6			1.7	1.6	
BOQ	1.8	10.5		12.4	10.6		4.7			0.2	2.5	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.6		1.6	1.6		1.8			2.0	1.9	
BOQ	2.1	11.5		13.6	11.6		5.3			0.3	2.9	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.8		1.8	1.8		2.2			2.6	2.3	
BOQ	2.7	13.1		15.2	13.2		6.4			0.3	3.6	
QSRatio												
98th Percentile Output:												
fB%	2.9	2.1		2.0	2.1		2.5			3.2	2.8	
BOQ	3.3	14.7		16.9	14.8		7.5			0.4	4.4	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								375	
Peak-Hour Factor, PHF								0.95	
Hourly Flow Rate, HFR								394	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided				/			
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		173							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		186							
Percent Heavy Vehicles		8							
Percent Grade (%)		0						0	
Flared Approach: Exists?/Storage								/	/
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			186							
C(m) (vph)			599							
v/c			0.31							
95% queue length			1.32							
Control Delay			13.7							
LOS			B							
Approach Delay				13.7						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					375	
Peak-Hour Factor, PHF					0.95	
Peak-15 Minute Volume					99	
Hourly Flow Rate, HFR					394	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume	173					
Peak Hour Factor, PHF	0.93					
Peak-15 Minute Volume	47					
Hourly Flow Rate, HFR	186					
Percent Heavy Vehicles	8					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 2: LT from Major St.		4		1
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Maj L-Shared Prob Q free St.				
Step 3: TH from Minor St.		8		11
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 4: LT from Minor St.		7		10
Conflicting Flows		394		
Potential Capacity		599		
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor				1.00
Maj. L, Min T Adj. Imp Factor.				1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity		599		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 394
Potential Capacity 599
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 599

Results for Two-stage process:
a
y
C t 599

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	186					
Movement Capacity (vph)	599					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	599					
Volume	186					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			186					
C(m) (vph)			599					
v/c			0.31					
95% queue length			1.32					
Control Delay			13.7					
LOS			B					
Approach Delay				13.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	46	18	32	41	0	10	0	21	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.80	0.80	0.78	0.78	0.86	0.86		
Flow Rate	28	50	66	26	11	24		
% Heavy Veh	21	21	1	1	5	5		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	28	50	66	26	11	24		
Left-Turn	0	0	41	0	11	0		
Right-Turn	0	22	0	0	0	24		
Prop. Left-Turns	0.0	0.0	0.6	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	28	50	66	26	11	24		
Service Time	2.7	2.4	2.7	2.3	2.6	1.8		
Utilization, x	0.04	0.07	0.09	0.03	0.01	0.03		
Dep. headway, hd	5.00	4.69	4.96	4.65	4.58	3.78		
Capacity	278	300	316	276	261	274		
Delay	7.90	7.72	8.15	7.51	7.65	6.88		
LOS	A	A	A	A	A	A		
Approach:								
Delay		7.78		7.97		7.12		
LOS		A		A		A		
Intersection Delay	7.76				Intersection	LOS A		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	52	32	134	172	394	6	228	72	50	10	95	99
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0				29.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 768 3005 0.32 0.26 28.2 C 28.2 C

Westbound

LTR 883 3455 0.75 0.26 36.2 D 36.2 D

Northbound

DefL 355 1101 0.74 0.32 40.0 D
 TR 571 1773 0.25 0.32 23.5 C 34.2 C

Southbound

LTR 863 2679 0.31 0.32 23.9 C 23.9 C

Intersection Delay = 32.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52	32	134	172	394	6	228	72	50	10	95	99
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	38	49	113	2	66	21	14	3	31	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		247			658		262	140			268	
%InSharedLn												
Prop LTs		0.239			0.301		1.000	0.000			0.049	
Prop RTs		0.615			0.011			0.407			0.485	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52	32	134	172	394	6	228	72	50	10	95	99
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	59	36	152	198	453	7	262	83	57	13	125	130
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	247			658			262 140			268		
Prop LTs	0.239			0.301			1.000 0.000			0.049		
Prop RTs	0.615			0.011			0.407			0.485		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.908			0.998			0.939			0.927		
fLT	0.988			0.985			0.583 1.000			0.941		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3005			3455			1101 1773			2679		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	247	3005	# 0.08	0.26	768	0.32
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	658	3455	# 0.19	0.26	883	0.75
Right							
Northbound							
Prot							
Perm							
Left	DefL	262	1101	# 0.24	0.32	355	0.74
Prot							
Perm							
Thru	TR	140	1773	0.08	0.32	571	0.25
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	268	2679	0.10	0.32	863	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.32	0.26	27.2	1.000	768	0.50	1.0	0.0	28.2	C	28.2	C	
Westbound													
LTR	0.75	0.26	30.8	1.000	883	0.50	5.4	0.0	36.2	D	36.2	D	
Northbound													
DefL	0.74	0.32	27.1	1.000	355	0.50	12.9	0.0	40.0	D			
TR	0.25	0.32	22.4	1.000	571	0.50	1.0	0.0	23.5	C	34.2	C	
Southbound													
LTR	0.31	0.32	23.0	1.000	863	0.50	0.9	0.0	23.9	C	23.9	C	

Intersection delay = 32.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			262	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			268	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.55	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			3.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			0.17	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			28.83	
n=Max(gq-gf)/2,0)			0.09	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.70	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			0.17	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.58	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.583	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	13
Proportion of LT in LT lane group, PLT	0.239 0.301 0.000 0.049
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	140
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.33
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	14.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.44
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.10
EL1 (refer to Exhibit C16-3)	1.60
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.941

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				140
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.049
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.615	0.011	0.407
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	27.2	0.00	0.0	0.0 0.0 0.0	28.2
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	30.8	0.00	0.0	0.0 0.0 0.0	36.2
Northbound								
DefL	0.0	0.00	30.5	27.1	0.00	0.0	0.0	40.0
TR	0.0 0.0	0.00	30.5	22.4	0.00	0.0	0.0 0.0	23.5
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	23.0	0.00	0.0	0.0 0.0 0.0	23.9
Intersection Delay			32.4	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	129		345		262	140	140	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	2 0	0 0	0 2 0	0 0	2 0	0 0
SL	1578		1814		1101	1773	1407	
LnCapacity	403		463		355	571	453	
Flow Ratio	0.1		0.2		0.2	0.1	0.1	
v/c Ratio	0.32		0.75		0.74	0.25	0.31	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.916		0.953			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	2.6		7.9		5.8	2.6	2.6	
kB	0.6		0.6		0.6	0.8	0.7	
Q2	0.3		1.7		1.4	0.2	0.3	
Q Average	2.9		9.6		7.2	2.8	2.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2		1.2	1.3	1.3	
BOQ	3.6		11.7		8.8	3.6	3.7	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.4		1.5	1.6	1.6	
BOQ	4.5		13.9		10.6	4.4	4.6	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.6		1.6	1.8	1.8	
BOQ	5.1		15.1		11.7	5.0	5.2	
QSRatio								
95th Percentile Output:								
fB%	2.2		1.7		1.8	2.2	2.2	
BOQ	6.2		16.8		13.2	6.1	6.3	
QSRatio								
98th Percentile Output:								
fB%	2.5		1.9		2.1	2.6	2.5	
BOQ	7.3		18.4		14.8	7.2	7.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	767	220	19	4	258	189	4	16	6	97	5	140
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	862	1728	0.98	0.71	36.0	D		
TR	1156	1626	0.23	0.71	4.8	A	28.5	C
Westbound								
LT	449	1835	0.68	0.24	38.3	D	37.2	D
R	383	1568	0.57	0.24	35.6	D		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.49	0.18	40.8	D		
LT	320	1801	0.02	0.18	30.6	C	20.9	C
R	952	1478	0.17	0.64	6.8	A		

Intersection Delay = 29.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	767	220	19	4	258	189	4	16	6	97	5	140
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	211	60	5	1	75	55	3	11	4	28	2	40
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	843	263			305	220		70		111	6	161
%InSharedLn										0		
Prop LTs	1.000	0.000			0.016			0.157		1.000	0.000	
Prop RTs		0.080			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	767	220	19	4	258	189	4	16	6	97	5	140
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	843	242	21	5	300	220	11	43	16	111	6	161
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L TR			LT R			LTR			L LT R		
Adj flow	843	263		305	220		70			111	6	161
Prop LTs	1.000	0.000		0.016			0.157			1.000	0.000	
Prop RTs	0.080			0.000	1.000		0.229			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.988		1.000	0.850		0.969				1.000	0.850
fLT	0.950	1.000		0.995			0.965			0.732	1.000	
Sec.	0.279											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1626		1835	1568		1995			1273	1801	1478
Sec.	508											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	L	710	1728	# 0.41	0.411	710	1.00
Perm		133	508	# 0.26	0.300	152	0.88
Left		843			0.71	862	0.98
Prot	TR						
Perm							
Thru		263	1626	0.16	0.71	1156	0.23
Right							
Westbound							
Prot	LT						
Perm							
Left							
Prot	R						
Perm							
Thru		305	1835	0.17	0.24	449	0.68
Right		220	1568	0.14	0.24	383	0.57
Northbound							
Prot	LTR						
Perm							
Left							
Prot	L						
Perm							
Thru		70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot	L						
Perm							
Left		111	1273	# 0.09	0.18	226	0.49
Prot	LT						
Perm							
Thru		6	1801	0.00	0.18	320	0.02
Right	R	161	1478	0.11	0.64	952	0.17

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.98	0.71	16.9	1.000	862	0.50	19.1	0.0	36.0	D			
TR	0.23	0.71	4.5	1.000	1156	0.50	0.3	0.0	4.8	A	28.5	C	
Westbound													
LT	0.68	0.24	30.8	1.000	449	0.50	7.5	0.0	38.3	D	37.2	D	
R	0.57	0.24	29.9	1.000	383	0.50	5.7	0.0	35.6	D			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.49	0.18	33.3	1.000	226	0.50	7.4	0.0	40.8	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	20.9	C	

R 0.17 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 29.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	843			111
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.02			0.16
Adjusted opposing flow rate, Vo (veh/h)	305			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.08			2.78
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.63			1.75
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	13.87			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.13			14.85
n=Max(gq-gf)/2,0)	6.94			0.58
PTHo=1-PLTo	0.98			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.74			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	6.61			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	13.87			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.28			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.279			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.016	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	263	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.57	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.81	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdif=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		263		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.016		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.080
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	843			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	13.87			
Unopposed green interval, gu	13.13			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.29			
XPerm	1.66			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	8.60			
Queue at beginning of unsaturated green, Qu	3.25			
Residual queue, Qr	2.51			
Uniform Delay, d1	16.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		16.9	0.00	0.0	0.0	36.0
TR	0.0	0.00	13.0	4.5	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	30.8	0.00	0.0	0.0	38.3
R	0.0	0.00	34.0	29.9	0.00	0.0	0.0	35.6
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.3	0.00	0.0	0.0	40.8
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8
Intersection Delay			29.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	843	263		305	220	70		111	6	161
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1213	1626		1835	1568	1995		1273	1801	1478
LnCapacity	862	1156		449	383	355		226	320	952
Flow Ratio	0.7	0.2		0.2	0.1	0.0		0.1	0.0	0.1
v/c Ratio	0.98	0.23		0.68	0.57	0.20		0.49	0.02	0.17
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	10.2	2.3		6.9	4.8	1.5		2.5	0.1	1.6
kB	0.6	0.8		0.6	0.5	0.6		0.4	0.5	1.1
Q2	7.0	0.2		1.2	0.7	0.1		0.4	0.0	0.2
Q Average	17.2	2.5		8.1	5.5	1.6		2.9	0.1	1.8
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	20.7	3.1		9.9	6.8	2.1		3.6	0.2	2.3
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5	1.5	1.6		1.6	1.7	1.6
BOQ	24.2	3.9		11.8	8.3	2.6		4.5	0.2	2.9
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.7	1.9		1.8	2.0	1.8
BOQ	26.0	4.5		13.0	9.2	3.0		5.1	0.3	3.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.2		1.8	1.9	2.3		2.2	2.6	2.3
BOQ	28.0	5.5		14.6	10.7	3.8		6.2	0.3	4.2
QSRatio										
98th Percentile Output:										
fB%	1.7	2.6		2.0	2.2	2.8		2.5	3.2	2.7
BOQ	30.0	6.5		16.2	12.2	4.5		7.3	0.4	5.0
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2015 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	298	25	0	14	66	36	6	21	10	15	36	351
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	702	1404	0.47	0.50	16.8	B		
TR	1066	2132	0.03	0.50	11.4	B	16.4	B

LTR	1545	3090	0.10	0.50	11.9	B	11.9	B
-----	------	------	------	------	------	---	------	---

LTR	1235	3176	0.07	0.39	17.4	B	17.4	B
-----	------	------	------	------	------	---	------	---

LT	671	1726	0.10	0.39	17.8	B	21.2	C
R	616	1583	0.42	0.39	22.1	C		

Intersection Delay = 17.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	298	25	0	14	66	36	6	21	10	15	36	351
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
PK 15 Vol	82	7	0	5	23	12	3	12	6	5	12	115
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155
Adj Flow	327	27			148			82			67	258
%InSharedLn												
Prop LTs	1.000	0.000			0.128			0.159			0.299	
Prop RTs		0.000			0.250			0.268			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.970		1.000			1.000			0.974		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	298	25	0	14	66	36	6	21	10	15	36	351
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	327	27	0	19	92	37	13	47	22	20	47	258
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	327	27			148			82			67	258
Prop LTs	1.000	0.000			0.128			0.159			0.299	
Prop RTs		0.000			0.250			0.268			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.962			0.960		1.000	0.850
fLT	0.658	1.000			0.930			0.924		0.927	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1404	2132			3090			3176		1726	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	327	1404	# 0.23	0.50	702	0.47
Prot							
Perm							
Thru	TR	27	2132	0.01	0.50	1066	0.03
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	148	3090	0.05	0.50	1545	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	82	3176	0.03	0.39	1235	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	67	1726	0.04	0.39	671	0.10
Right	R	258	1583	# 0.16	0.39	616	0.42

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.47	0.50	14.7	1.000	702	0.50	2.1	0.0	16.8	B			
TR	0.03	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.4	B	16.4	B	
Westbound													
LTR	0.10	0.50	11.8	1.000	1545	0.50	0.1	0.0	11.9	B	11.9	B	
Northbound													
LTR	0.07	0.39	17.3	1.000	1235	0.50	0.1	0.0	17.4	B	17.4	B	
Southbound													
LT	0.10	0.39	17.5	1.000	671	0.50	0.3	0.0	17.8	B	21.2	C	

R 0.42 0.39 20.1 1.000 616 0.50 2.0 0.0 22.1 C

Intersection delay = 17.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	327			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.13			
Adjusted opposing flow rate, Vo (veh/h)	148			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	8.18			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.94			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.87			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.52			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.658			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No		2	1	2
Adjusted LT flow rate, VLT (veh/h)		19	13	20
Proportion of LT in LT lane group, PLT	0.000	0.128	0.159	0.299
Proportion of LT in opposing flow, PLTo		0.00	0.30	0.16
Adjusted opposing flow rate, Vo (veh/h)		27	67	82
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		0.48	0.33	0.50
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.34	1.67	1.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.8	18.6	15.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		23.17	16.40	19.53
n=Max(gq-gf)/2,0)		0.00	0.00	0.00
PTHo=1-PLTo		1.00	0.70	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.26	0.32	0.30
EL1 (refer to Exhibit C16-3)		1.42	1.48	1.51
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	0.08	0.07
gdifff=max(gq-gf,0)		0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	0.94	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.930	0.924	0.927

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	148	27	67	82
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.128	0.159	0.299
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.250	0.268	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	14.7	0.00	0.0	0.0	16.8
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.3	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.5	0.00	0.0	0.0	17.8
R	0.0	0.00	27.5	20.1	0.00	0.0	0.0	22.1
Intersection Delay			17.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	327	27			77				43				67	258	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1404	2132			1622				1668				1726	1583	
LnCapacity	702	1066			811				648				671	616	
Flow Ratio	0.2	0.0			0.0				0.0				0.0	0.2	
v/c Ratio	0.47	0.03			0.09				0.07				0.10	0.42	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.970			1.000				1.000				0.974		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	5.3	0.3			1.0				0.7				1.1	4.7	
kB	0.9	1.2			1.0				0.8				0.8	0.8	
Q2	0.7	0.0			0.1				0.1				0.1	0.6	
Q Average	6.1	0.4			1.1				0.7				1.2	5.3	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	7.5	0.5			1.4				0.9				1.5	6.5	
QSRatio															
85th Percentile Output:															
fB%	1.5	1.7			1.6				1.7				1.6	1.5	
BOQ	9.0	0.6			1.8				1.2				1.9	7.9	
QSRatio															
90th Percentile Output:															
fB%	1.6	2.0			1.9				1.9				1.9	1.7	
BOQ	10.0	0.7			2.1				1.4				2.2	8.8	
QSRatio															
95th Percentile Output:															
fB%	1.9	2.5			2.4				2.5				2.4	1.9	
BOQ	11.5	0.9			2.7				1.8				2.8	10.3	
QSRatio															
98th Percentile Output:															
fB%	2.1	3.1			2.9				3.0				2.9	2.2	
BOQ	13.0	1.2			3.2				2.2				3.3	11.7	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	62		4				4	88			568	211
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.14	0.32	15.3	B	15.3	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								

Northbound

LT 1667 3226 0.07 0.52 7.3 A 7.3 A

Southbound

TR 2012 3895 0.48 0.52 9.9 A 9.9 A

Intersection Delay = 10.0+ (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62		4				4	88		568	211	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	19		1				1	27		175	65	
Hi Ln Vol												
% Grade		0						0				
Ideal Sat	1900		1900					1900				
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	77		0					115			961	
%InSharedLn												
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.271	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995					1.000			0.752		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62		4				4	88		568	211	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	77		0				5	110		701	260	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	77		0					115			961	
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.271	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.959	
fLT	0.950				0.925		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3226		3895	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	77	1680	# 0.05	0.32	532	0.14
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	115	3226	0.04	0.52	1667	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	961	3895	# 0.25	0.52	2012	0.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.29
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.35

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.14	0.32	14.7	1.000	532	0.50	0.6	0.0	15.3	B	15.3	B
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B		
Westbound												
Northbound												
LT	0.07	0.52	7.3	1.000	1667	0.50	0.1	0.0	7.3	A	7.3	A
Southbound												
TR	0.48	0.52	9.3	1.000	2012	0.50	0.6	0.0	9.9	A	9.9	A

Intersection delay = 10.0+ (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.043 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	961
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.41
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	6.30
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	3.77
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.925

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.30	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.203	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			961	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.043	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.271
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	14.7	0.00	0.0	0.0	15.3
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.3	0.00	0.0	0.0	7.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.3	0.00	0.0	0.0	9.9
	0.0						0.0	

Intersection Delay	10.0+	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	77	0				60		504	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1694		2045	
LnCapacity	532	461				875		1056	
Flow Ratio	0.0	0.0				0.0		0.2	
v/c Ratio	0.14	0.00				0.07		0.48	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	0.9	0.0				0.5		5.4	
kB	0.6	0.5				0.8		0.7	
Q2	0.1	0.0				0.1		0.6	
Q Average	1.0	0.0				0.6		6.0	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	1.3	0.0				0.7		7.4	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	1.7	0.0				0.9		8.9	
QSRatio									
90th Percentile Output:									
fB%	1.9	2.0				1.9		1.7	
BOQ	1.9	0.0				1.1		9.9	
QSRatio									
95th Percentile Output:									
fB%	2.4	2.6				2.5		1.9	
BOQ	2.4	0.0				1.4		11.4	
QSRatio									
98th Percentile Output:									
fB%	2.9	3.2				3.0		2.2	
BOQ	3.0	0.0				1.7		12.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		406	1		3			23	373	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.43	0.42	14.6	B		
LT	576	1382	0.45	0.42	15.0	B	14.8	B

Northbound

L	320	768	0.01	0.42	10.3	B	10.3	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2058	4939	0.24	0.42	11.6	B	11.6	B
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Intersection Delay = 13.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		406	1		3			23	373	0
% Heavy Veh	2	2		3	3		1			1	1	1
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol	1	0		128	1		1			7	115	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			257	258		4			488		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.996		1.000				0.057	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.981			0.998		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		406	1		3			23	373	0
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	4	0		514	1		4			28	460	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			257	258		4			488		
Prop LTs	0.000			1.000 0.996			1.000			0.057		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.437		0.997	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1439 1382		768		4939	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1863	0.00	0.42	776	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	257	1439	0.18	0.42	600	0.43
Prot							
Perm							
Thru	LT	258	1382	# 0.19	0.42	576	0.45
Right							
Northbound							
Prot							
Perm							
Left	L	4	768	0.01	0.42	320	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	488	4939	# 0.10	0.42	2058	0.24
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.29
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.34

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	776	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.43	0.42	12.4	1.000	600	0.50	2.2	0.0	14.6	B		
LT	0.45	0.42	12.6	1.000	576	0.50	2.5	0.0	15.0	B	14.8	B
Northbound												
L	0.01	0.42	10.3	1.000	320	0.50	0.1	0.0	10.3	B	10.3	B
Southbound												
LTR	0.24	0.42	11.3	1.000	2058	0.50	0.3	0.0	11.6	B	11.6	B

Intersection delay = 13.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		257	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.06	
Adjusted opposing flow rate, Vo (veh/h)		4	488	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.28	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	2.99	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	1.42	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	23.58	
n=Max(gq-gf)/2,0)		0.00	0.71	
PTHo=1-PLTo		1.00	0.94	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.16	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	1.42	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.44	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.437	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	257		
Proportion of LT in LT lane group, PLT	0.000	0.996	0.057
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		4	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		4.28	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.725	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	4		257	258	4			179	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	3	0
SL	1863		1439	1382	768			1813	
LnCapacity	776		600	576	320			755	
Flow Ratio	0.0		0.2	0.2	0.0			0.1	
v/c Ratio	0.01		0.43	0.45	0.01			0.24	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.981		0.998			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		3.0	3.1	0.0			1.9	
kB	0.7		0.6	0.6	0.4			0.7	
Q2	0.0		0.4	0.5	0.0			0.2	
Q Average	0.0		3.5	3.5	0.0			2.1	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.2	1.3			1.3	
BOQ	0.1		4.3	4.4	0.1			2.7	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.5	1.7			1.6	
BOQ	0.1		5.4	5.5	0.1			3.4	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.7	1.7	2.0			1.8	
BOQ	0.1		6.1	6.2	0.1			3.9	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.1	2.1	2.6			2.3	
BOQ	0.1		7.3	7.4	0.1			4.8	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.4	2.4	3.2			2.7	
BOQ	0.1		8.5	8.6	0.1			5.8	
QSRatio									

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound		
		1 L	2 T	3 R		4 L	5 T	6 R

Volume		24						
Peak-Hour Factor, PHF		0.82						
Hourly Flow Rate, HFR		29						
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage	Undivided				/			
RT Channelized?								
Lanes		1						
Configuration		T						
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Northbound				Southbound		
		7 L	8 T	9 R		10 L	11 T	12 R

Volume				147				
Peak Hour Factor, PHF				0.78				
Hourly Flow Rate, HFR				188				
Percent Heavy Vehicles				1				
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			/
Lanes			1					
Configuration			R					

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)					188			
C(m) (vph)					1049			
v/c					0.18			
95% queue length					0.65			
Control Delay					9.2			
LOS					A			
Approach Delay				9.2				
Approach LOS				A				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		24				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		7				
Hourly Flow Rate, HFR		29				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			147			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			47			
Hourly Flow Rate, HFR			188			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					29			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	29	
Potential Capacity	1049	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1049	
Probability of Queue free St.	0.82	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.82
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.82
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	---------	---------	---------

Volume (vph)			188			
Movement Capacity (vph)			1049			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1049			
Volume			188			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					188			
C(m) (vph)					1049			
v/c					0.18			
95% queue length					0.65			
Control Delay					9.2			
LOS					A			
Approach Delay				9.2				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	60	21	99	74	0	0	0	0	12	65	27
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	100		218				53 73	
% Heavy Veh	24		5				3 3	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	100		218				53	73
Left-Turn	0		125				14	0
Right-Turn	26		0				0	33
Prop. Left-Turns	0.0		0.6				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.5
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	66	0	0	116	20	56	51	52	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	89		171		92		88	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	89		171		92	88		
Left-Turn	7		0		64	0		
Right-Turn	0		25		0	59		
Prop. Left-Turns	0.1		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	77	51	44	6	39	1	368	74	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	533	1523	0.30	0.35	15.7	B	15.3	B
R	549	1568	0.05	0.35	13.1	B		

Westbound

LTR	546	1560	0.11	0.35	13.6	B	13.6	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2253	4662	0.26	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 11.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	77	51	44	6	39	1	368	74	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	24	16	14	2	12	1	121	24	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		162	29		58			582				
%InSharedLn												
Prop LTs		0.599			0.138			0.832				
Prop RTs		0.000	1.000		0.017			0.002				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0						29.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	77	51	44	6	39	1	368	74	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	97	65	29	8	49	1	484	97	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		162	29		58			582				
Prop LTs		0.599			0.138			0.832				
Prop RTs		0.000	1.000		0.017			0.002				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.971	0.971		0.990			0.971	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.998			1.000	
fLT	0.799			0.966			0.960	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1523	1568		1560			4662	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	162	1523	# 0.11	0.35	533	0.30
Right	R	29	1568	0.02	0.35	549	0.05
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	58	1560	0.04	0.35	546	0.11
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	582	4662	# 0.12	0.48	2253	0.26
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Intersection delay = 11.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	97	8	
Proportion of LT in LT lane group, PLT	0.599	0.138	0.832
Proportion of LT in opposing flow, PLTo	0.14	0.60	
Adjusted opposing flow rate, Vo (veh/h)	58	162	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.62	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97	2.70	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.6	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	1.67	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.44	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.86	0.40	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.60	0.14	
EL1 (refer to Exhibit C16-3)	1.46	1.63	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.80	0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.799	0.966	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	1.67		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.080		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	58	162	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.599	0.138	0.832	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.017	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.2	0.00	0.0	0.0	15.7
R	0.0	0.00	19.5	12.9	0.00	0.0	0.0	13.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			11.1	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LT	R			LTR			LTR			
Init Queue		0.0	0.0			0.0			0.0			
Flow Rate		162	29			58			213			
So		1900	1900			1900			1900			
No.Lanes	0	1	1	0		1	0	0	3	0	0	0
SL		1523	1568			1560			1711			
LnCapacity		533	549			546			827			
Flow Ratio		0.1	0.0			0.0			0.1			
v/c Ratio		0.30	0.05			0.11			0.26			
Grn Ratio		0.35	0.35			0.35			0.48			
I Factor		0.999				0.998			0.978			
AT or PVG		3	3			3			3			
Pltn Ratio		1.00	1.00			1.00			1.00			
PF2		1.00	1.00			1.00			1.00			
Q1		2.0	0.3			0.7			2.1			
kB		0.6	0.6			0.6			0.7			
Q2		0.2	0.0			0.1			0.3			
Q Average		2.2	0.4			0.7			2.3			
Q Spacing		25.0	25.0			25.0			25.0			
Q Storage		0	0			0			0			
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3			1.3			1.3			
BOQ		2.8	0.5			0.9			3.0			
QSRatio												
85th Percentile Output:												
fB%		1.6	1.7			1.7			1.6			
BOQ		3.5	0.6			1.2			3.7			
QSRatio												
90th Percentile Output:												
fB%		1.8	2.0			1.9			1.8			
BOQ		4.0	0.7			1.4			4.3			
QSRatio												
95th Percentile Output:												
fB%		2.2	2.5			2.5			2.2			
BOQ		4.9	0.9			1.8			5.2			
QSRatio												
98th Percentile Output:												
fB%		2.7	3.1			3.0			2.6			
BOQ		5.9	1.1			2.2			6.2			
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	34		18				16	333		461	30	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	459	1723	0.15	0.27	17.5	B	17.5	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1011	1785	0.39	0.57	8.3	A	8.3	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1102	1944	0.52	0.57	9.4	A	9.4	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 9.5 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	34		18				16	333		461	30	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	11		6				4	94		134	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		70						392			571	
%InSharedLn												
Prop LTs		0.657						0.046			0.000	
Prop RTs		0.343						0.000			0.061	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	34		18				16	333		461	30	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	46		24				18	374		536	35	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		70						392			571	
Prop LTs		0.657						0.046			0.000	
Prop RTs	0.343						0.000			0.061		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.954						1.000			0.992		
fLT	0.968						0.970			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1723						1785			1944		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	70	1723	# 0.04	0.27	459	0.15
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	392	1785	0.22	0.57	1011	0.39
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	571	1944	# 0.29	0.57	1102	0.52
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.33

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.15	0.27	16.8	1.000	459	0.50	0.7	0.0	17.5	B	17.5	B
Westbound												
Northbound												
LT	0.39	0.57	7.2	1.000	1011	0.50	1.1	0.0	8.3	A	8.3	A
Southbound												
TR	0.52	0.57	8.0	1.000	1102	0.50	1.4	0.0	9.4	A	9.4	A

Intersection delay = 9.5 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g or fmin=2(1+PL)/g
gdifff=max(gq-gf,0)
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.657	0.046	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		571	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.52	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.33	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.47	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.970	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.33	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.186	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			571	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.046	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.061
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	16.8	0.00	0.0	0.0	17.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.2	0.00	0.0	0.0	8.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.0	0.00	0.0	0.0	9.4
	0.0						0.0	
Intersection Delay			9.5	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	70						392			571		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1723						1785			1944		
LnCapacity	459						1011			1102		
Flow Ratio	0.0						0.2			0.3		
v/c Ratio	0.15						0.39			0.52		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	0.9						3.6			5.8		
kB	0.5						0.8			0.7		
Q2	0.1						0.5			0.8		
Q Average	1.0						4.1			6.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	1.3						5.1			8.1		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	1.6						6.3			9.8		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.6		
BOQ	1.9						7.1			10.8		
QSRatio												
95th Percentile Output:												
fB%	2.4						2.0			1.9		
BOQ	2.4						8.4			12.4		
QSRatio												
98th Percentile Output:												
fB%	2.9						2.4			2.1		
BOQ	2.9						9.7			13.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	68		51				29	390		315	107	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								17	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 505 1514 0.30 0.33 16.2 B 16.2 B

Westbound

Northbound

LT 807 1613 0.58 0.50 13.3 B 13.3 B

Southbound

TR 934 1867 0.50 0.50 11.8 B 11.8 B

Intersection Delay = 13.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	68		51				29	390		315	107	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	21		16				8	110		92	31	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		149						471			471	
%InSharedLn												
Prop LTs		0.570						0.070			0.000	
Prop RTs	0.430						0.000			0.223		
Peds Bikes	0	0		0						0	0	
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	68		51				29	390		315	107	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	85		64				33	438		366	105	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		149						471			471	
Prop LTs		0.570						0.070			0.000	
Prop RTs	0.430						0.000			0.223		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.942						1.000			0.970		
fLT	0.972						0.951			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1514						1613			1867		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	149	1514	# 0.10	0.33	505	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	471	1613	# 0.29	0.50	807	0.58
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	471	1867	0.25	0.50	934	0.50
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.39

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.30	0.33	14.8	1.000	505	0.50	1.5	0.0	16.2	B	16.2	B
Westbound												
Northbound												
LT	0.58	0.50	10.6	1.000	807	0.50	2.7	0.0	13.3	B	13.3	B
Southbound												
TR	0.50	0.50	10.0	1.000	934	0.50	1.8	0.0	11.8	B	11.8	B

Intersection delay = 13.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		33		
Proportion of LT in LT lane group, PLT	0.570	0.070	0.000	
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		471		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.55		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.85		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		11.6		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		6.39		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.38		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.07		
EL1 (refer to Exhibit C16-3)		2.23		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.951		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			6.39	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.213	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		471	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.570		0.070	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.430	0.223
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	14.8	0.00	0.0	0.0 0.0 0.0	16.2
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	10.6	0.00	0.0	0.0 0.0 0.0	13.3
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	10.0	0.00	0.0	0.0 0.0 0.0	11.8
Intersection Delay			13.1	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	149						471			471		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1514						1613			1867		
LnCapacity	505						807			934		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.30						0.58			0.50		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.8						5.5			5.2		
kB	0.5						0.6			0.8		
Q2	0.2						0.9			0.8		
Q Average	2.1						6.4			6.0		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.6						7.9			7.4		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.3						9.5			9.0		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.7		
BOQ	3.8						10.5			9.9		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	4.6						12.1			11.4		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.2		
BOQ	5.5						13.6			12.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		56	234	382	158	41	187		458	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	27.2	C
R	216	1620	0.33	0.13	27.5	C		
Westbound								
LTR	1314	4638	0.67	0.28	21.0	C	21.0	C
Northbound								
L	120	355	0.38	0.33	23.8	C		
T	575	1726	0.36	0.33	16.8	B	18.1	B
Southbound								
TR	661	1984	0.95	0.33	30.5	C	30.5	C

Intersection Delay = 24.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		56	234	382	158	41	187		458	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		18	66	109	45	11	52		151	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		71		880		46	208			631	
%InSharedLn												
Prop LTs					0.302		1.000	0.000			0.000	
Prop RTs			1.000		0.205			0.000			0.044	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds	X	
WB	Left			P			SB	Left		
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds			X				Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		8.0		17.0					20.0	
Yellow		3.0		3.0					3.0	
All Red		2.0		2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		56	234	382	158	41	187		458	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		71	266	434	180	46	208		603	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	4		71		880		46	208			631	
Prop LTs					0.302		1.000	0.000			0.000	
Prop RTs			1.000		0.205			0.000			0.044	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.971	0.971	0.971		0.935	0.935	0.935	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.972	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.969			1.000	0.994	
fLT	0.950		0.985		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1636	1620	4638		355	1726	1984	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	71	1620	# 0.04	0.13	216	0.33
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	880	4638	# 0.19	0.28	1314	0.67
Right							
Northbound							
Prot							
Perm							
Left	L	46	355	0.13	0.33	120	0.38
Prot							
Perm							
Thru	T	208	1726	0.12	0.33	575	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	631	1984	# 0.32	0.33	661	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	27.2	C	
R	0.33	0.13	23.6	1.000	216	0.50	3.9	0.0	27.5	C			
Westbound													
LTR	0.67	0.28	19.0	1.000	1314	0.50	2.0	0.0	21.0	C	21.0	C	
Northbound													
L	0.38	0.33	15.3	1.000	120	0.50	8.6	0.0	23.8	C	18.1	B	
T	0.36	0.33	15.2	1.000	575	0.50	1.7	0.0	16.8	B			
Southbound													
TR	0.95	0.33	19.6	1.000	661	0.50	10.9	0.0	30.5	C	30.5	C	

Intersection delay = 24.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			46	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			631	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			0.77	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			14.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.69	
n=Max(gq-gf)/2,0)			7.16	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.302 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.31	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.716	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			631	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.205	0.044
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	23.6	0.00	0.0	0.0	27.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.0	0.00	0.0	0.0	21.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.3	0.00	0.0	0.0	23.8
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.6	0.00	0.0	0.0	30.5
	0.0						0.0	
Intersection Delay			24.1	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	71		323		46	208		631
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1636	1620		1702		355	1726		1984
LnCapacity	218	216		482		120	575		661
Flow Ratio	0.0	0.0		0.2		0.1	0.1		0.3
v/c Ratio	0.02	0.33		0.67		0.38	0.36		0.95
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.1		4.8		0.6	2.6		10.3
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	0.1		0.7		0.1	0.3		2.4
Q Average	0.1	1.2		5.5		0.7	2.9		12.7
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	1.5		6.8		0.9	3.7		15.3
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.7	1.6		1.4
BOQ	0.1	2.0		8.2		1.2	4.6		18.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.9		1.7		1.9	1.8		1.5
BOQ	0.1	2.3		9.2		1.4	5.2		19.5
QSRatio									
95th Percentile Output:									
fB%	2.6	2.4		1.9		2.5	2.2		1.7
BOQ	0.2	2.9		10.6		1.7	6.3		21.3
QSRatio									
98th Percentile Output:									
fB%	3.2	2.9		2.2		3.0	2.5		1.8
BOQ	0.2	3.5		12.1		2.1	7.4		23.1
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	11	37	10				5	216	84	251	466	31
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 457 1614 0.15 0.28 16.8 B 16.8 B

Westbound

Northbound

LTR 899 1634 0.38 0.55 8.8 A 8.8 A

Southbound

L 555 1009 0.57 0.55 11.0 B
 TR 960 1745 0.65 0.55 11.2 B 11.1 B

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	11	37	10				5	216	84	251	466	31
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	3	11	3				2	60	23	78	146	10
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig			LTR						LTR	L		TR
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		69						339		314	621	
%InSharedLn												
Prop LTs			0.188						0.018	1.000	0.000	
Prop RTs		0.174						0.274			0.063	
Peds Bikes	0		0	0			0		0	0		0
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	11	37	10				5	216	84	251	466	31
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	13	44	12				6	240	93	314	582	39
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	69						339			314	621	
Prop LTs	0.188						0.018			1.000	0.000	
Prop RTs	0.174						0.274			0.063		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.971							0.935			0.935	0.935	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.972			1.000	0.992	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.977							0.963				0.991	
fLT	0.991							0.992			0.568	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1614							1634			1009	1745	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	69	1614	# 0.04	0.28	457	0.15
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	339	1634	0.21	0.55	899	0.38
Right							
Southbound							
Prot							
Perm							
Left	L	314	1009	0.31	0.55	555	0.57
Prot							
Perm							
Thru	TR	621	1745	# 0.36	0.55	960	0.65
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.40$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.48$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.15	0.28	16.1	1.000	457	0.50	0.7	0.0	16.8	B	16.8	B
Westbound												
Northbound												
LTR	0.38	0.55	7.7	1.000	899	0.50	1.1	0.0	8.8	A	8.8	A
Southbound												
L	0.57	0.55	8.8	1.000	555	0.50	2.2	0.0	11.0	B		
TR	0.65	0.55	9.4	1.000	960	0.50	1.8	0.0	11.2	B	11.1	B

Intersection delay = 10.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				314
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				339
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.23
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				5.65
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				2.93
gu=g-gq if gq>=gf, or = g-gf if gq<gf				30.07
n=Max(gq-gf)/2,0)				1.46
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.80
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.46
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				2.93
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.57
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.568

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		6	
Proportion of LT in LT lane group, PLT	0.188	0.018	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		621	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.10	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.35	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		7.57	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.14	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.59	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.57	2.93
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.229	0.089
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			621	339
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.018	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.174	0.274	0.063
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.8
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.7	0.00	0.0	0.0	8.8
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.8	0.00	0.0	0.0	11.0
TR	0.0	0.00	13.5	9.4	0.00	0.0	0.0	11.2
	0.0						0.0	
Intersection Delay			10.8	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		69						339			314	621
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1614						1634			1009	1745
LnCapacity		457						899			555	960
Flow Ratio		0.0						0.2			0.3	0.4
v/c Ratio		0.15						0.38			0.57	0.65
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.941				0.518
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.9						3.2			3.4	7.2
kB		0.5						0.8			0.3	0.4
Q2		0.1						0.5			0.4	0.8
Q Average		0.9						3.7			3.8	8.0
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.2						4.6			4.7	9.8
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		1.6						5.7			5.9	11.7
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.8						6.4			6.6	12.8
QSRatio												
95th Percentile Output:												
fB%		2.4						2.1			2.1	1.8
BOQ		2.3						7.6			7.9	14.4
QSRatio												
98th Percentile Output:												
fB%		2.9						2.4			2.4	2.0
BOQ		2.8						8.9			9.1	16.0
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	20	12	166	16	101	9	161	127	134	288	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 652 1466 0.09 0.44 14.7 B 14.7 B

Westbound

L 549 1235 0.34 0.44 18.1 B
 T 777 1749 0.02 0.44 14.1 B 17.1 B
 R 574 1291 0.20 0.44 16.0 B

Northbound

LTR 689 1550 0.48 0.44 19.7 B 19.7 B

Southbound

LTR 563 1267 1.01 0.44 37.7 D 37.7 D

Intersection Delay = 26.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	20	12	166	16	101	9	161	127	134	288	8
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	4	47	5	29	3	45	35	44	95	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		189	18	115		330			566	
%InSharedLn												
Prop LTs		0.175		1.000	0.000			0.030			0.311	
Prop RTs		0.316			0.000	1.000		0.427			0.019	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.966			0.850			0.090	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	20	12	166	16	101	9	161	127	134	288	8
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	10	29	18	189	18	115	10	179	141	176	379	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	57			189	18	115	330			566		
Prop LTs	0.175			1.000	0.000		0.030			0.311		
Prop RTs	0.316			0.000 1.000			0.427			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.971		0.952	0.952	0.952	0.935		0.935		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.957		1.000 0.850			0.942		0.997		
fLT	0.973		0.720	1.000		0.982		0.722		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.990		
fRpb	0.982		1.000 1.000			0.976		1.000		
S	1466		1235	1749	1291	1550		1267		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1466	0.04	0.44	652	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	189	1235	# 0.15	0.44	549	0.34
Prot							
Perm							
Thru	T	18	1749	0.01	0.44	777	0.02
Right	R	115	1291	0.09	0.44	574	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	330	1550	0.21	0.44	689	0.48
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	566	1267	# 0.45	0.44	563	1.01
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.60$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.67$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	652	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.34	0.44	16.4	1.000	549	0.50	1.7	0.0	18.1	B	17.1	B
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B		
R	0.20	0.44	15.2	1.000	574	0.50	0.8	0.0	16.0	B		
Northbound												
LTR	0.48	0.44	17.6	1.000	689	0.50	2.0	0.0	19.7	B	19.7	B
Southbound												
LTR	1.01	0.44	25.0	1.000	563	0.50	12.7	0.0	37.7	D	37.7	D

Intersection delay = 26.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		189		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.18		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.72		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.82		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	10	176
Proportion of LT in LT lane group, PLT	0.175	0.000	0.030
Proportion of LT in opposing flow, PLTo	0.00	0.31	0.03
Adjusted opposing flow rate, Vo (veh/h)	18	566	330
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.25	4.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45	14.15	8.25
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	22.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.95	8.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	17.08	31.77
n=Max(gq-gf)/2,0)	0.00	0.00	4.11
PTHo=1-PLTo	1.00	0.69	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.18	0.03	0.31
EL1 (refer to Exhibit C16-3)	1.40	2.45	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	3.92
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.07
gdifff=max(gq-gf,0)	0.00	0.00	8.23
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.98	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.973	0.982	0.722

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.95	8.23
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.374	0.206
OCCpedu	0.000	0.056	0.000	0.050
Opposing flow rate, Vo (veh/h)	18	57	566	330
OCCr	0.000	0.052	0.000	0.032
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.968
Proportion of left turns, PLT	0.175	1.000	0.030	0.311
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.990
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.316	1.000	0.427	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.976	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	16.4	0.00	0.0	0.0	18.1
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	17.6	0.00	0.0	0.0	19.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	0.8	0.0	37.7
	0.0						0.0	
Intersection Delay			26.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		57	189	18	115		330		566
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1466	1235	1749	1291		1550		1267
LnCapacity		652	549	777	574		689		563
Flow Ratio		0.0	0.2	0.0	0.1		0.2		0.4
v/c Ratio		0.09	0.34	0.02	0.20		0.48		1.01
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	3.1	0.3	1.8		5.8		14.1
kB		0.8	0.7	0.9	0.7		0.7		0.1
Q2		0.1	0.4	0.0	0.2		0.7		2.4
Q Average		0.9	3.5	0.3	1.9		6.5		16.6
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.2	4.3	0.4	2.5		8.0		19.9
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.5		1.4
BOQ		1.5	5.4	0.5	3.1		9.6		23.4
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		1.7	6.1	0.5	3.6		10.6		25.1
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.9		1.6
BOQ		2.2	7.3	0.7	4.4		12.2		27.1
QSRatio									
98th Percentile Output:									
fB%		3.0	2.4	3.1	2.7		2.1		1.8
BOQ		2.7	8.5	0.9	5.3		13.7		29.0
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	127		182	55		155	217		60			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	892	1784	0.32	0.50	14.3	B	14.3	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	815	1629	0.29	0.50	14.0	B	14.0	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	536	1377	0.55	0.39	24.8	C	24.8	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 18.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		127	182	55	155		217		60			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		35	49	15	44		58		16			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		288			236			295				
%InSharedLn												
Prop LTs		0.000			0.263			0.783				
Prop RTs		0.521			0.000			0.217				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		127	182	55	155		217		60			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		138	150	62	174		231		64			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		288			236			295				
Prop LTs		0.000			0.263			0.783				
Prop RTs		0.521			0.000			0.217				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.930			1.000			0.971					
fLT	1.000			0.855			0.962					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1784			1629			1377					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.32	0.50	13.4	1.000	892	0.50	0.9	0.0	14.3	B	14.3	B
Westbound												
LT	0.29	0.50	13.2	1.000	815	0.50	0.9	0.0	14.0	B	14.0	B
Northbound												
LR	0.55	0.39	21.4	1.000	536	0.50	3.5	0.0	24.8	C	24.8	C
Southbound												

Intersection delay = 18.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	62		
Proportion of LT in LT lane group, PLT	0.000	0.263	0.783
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	288		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	1.55		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.20		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.5		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	5.66		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.51		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.26		
EL1 (refer to Exhibit C16-3)	1.86		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.85		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.855		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.4	0.00	0.0	0.0	14.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	13.2	0.00	0.0	0.0	14.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	21.4	0.00	0.0	0.0	24.8
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			18.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		288			236			295				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1784			1629			1377				
LnCapacity		892			815			536				
Flow Ratio		0.2			0.1			0.2				
v/c Ratio		0.32			0.29			0.55				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.964			0.986			0.858				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		4.3			3.4			5.7				
kB		1.0			1.0			0.6				
Q2		0.5			0.4			0.8				
Q Average		4.8			3.8			6.5				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		5.9			4.8			8.0				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		7.2			5.9			9.6				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.7			1.6				
BOQ		8.1			6.7			10.6				
QSRatio												
95th Percentile Output:												
fB%		2.0			2.1			1.9				
BOQ		9.5			7.9			12.2				
QSRatio												
98th Percentile Output:												
fB%		2.3			2.4			2.1				
BOQ		10.9			9.2			13.7				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	23	17	37	34	19	24	35	203	35	31	214	22
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 229 1965 0.43 0.12 30.4 C 30.4 C

Westbound

LTR 459 1836 0.19 0.25 18.7 B 18.7 B

Northbound

LTR 690 1799 0.47 0.38 16.1 B 16.1 B

Southbound

LTR 639 1668 0.46 0.38 16.2 B 16.2 B

Intersection Delay = 18.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	23	17	37	34	19	24	35	203	35	31	214	22
% Heavy Veh	1	1	1	10	10	10	8	8	8	18	18	18
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
PK 15 Vol	7	5	12	10	5	7	10	60	10	9	59	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		98			88			321			293	
%InSharedLn												
Prop LTs		0.296			0.443			0.128			0.116	
Prop RTs		0.480			0.307			0.128			0.082	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			3			3	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	23	17	37	34	19	24	35	203	35	31	214	22
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
Adj flow	29	22	47	39	22	27	41	239	41	34	235	24
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	98			88			321			293		
Prop LTs	0.296			0.443			0.128			0.116		
Prop RTs	0.480			0.307			0.128			0.082		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.990			0.909			0.926			0.847		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.988			0.988		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.935			0.959			0.983			0.989		
fLT	0.985			0.978			0.929			0.935		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1965			1836			1799			1668		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	98	1965	# 0.05	0.12	229	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1836	# 0.05	0.25	459	0.19
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	321	1799	# 0.18	0.38	690	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	293	1668	0.18	0.38	639	0.46
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.28
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.37

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.43	0.12	24.6	1.000	229	0.50	5.8	0.0	30.4	C	30.4	C	
Westbound													
LTR	0.19	0.25	17.7	1.000	459	0.50	0.9	0.0	18.7	B	18.7	B	
Northbound													
LTR	0.47	0.38	13.9	1.000	690	0.50	2.2	0.0	16.1	B	16.1	B	
Southbound													
LTR	0.46	0.38	13.8	1.000	639	0.50	2.4	0.0	16.2	B	16.2	B	

Intersection delay = 18.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			41	34
Proportion of LT in LT lane group, PLT	0.296	0.443	0.128	0.116
Proportion of LT in opposing flow, PLTo			0.12	0.13
Adjusted opposing flow rate, Vo (veh/h)			293	321
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.68	0.57
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.88	5.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.7	7.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			4.91	5.62
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.31	15.40
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.88	0.87
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.13	0.12
EL1 (refer to Exhibit C16-3)			1.87	1.92
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.93	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.929	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.62
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.244
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				321
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.116
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.480	0.128
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	30.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.7	0.00	0.0	0.0	18.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.9	0.00	0.0	0.0	16.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.8	0.00	0.0	0.0	16.2
	0.0						0.0	
Intersection Delay			18.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	98		88		321		293	
So	1900		1900		1900		1900	
No.Lanes	1	0	1	0	1	0	1	0
SL	1965		1836		1799		1668	
LnCapacity	229		459		690		639	
Flow Ratio	0.0		0.0		0.2		0.2	
v/c Ratio	0.43		0.19		0.47		0.46	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.5		1.2		4.0		3.7	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.1		0.6		0.5	
Q Average	1.7		1.3		4.6		4.2	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.2		1.6		5.7		5.2	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.8		2.1		7.0		6.4	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.9		1.7		1.7	
BOQ	3.2		2.4		7.8		7.2	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.4		2.0		2.0	
BOQ	4.0		3.0		9.2		8.5	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.9		2.3		2.4	
BOQ	4.8		3.6		10.5		9.8	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			259	18		19	267	
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91	
Hourly Flow Rate, HFR			304	21		20	293	
Percent Heavy Vehicles			--	--		15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		43		15				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		45		15				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4		7	8	9		10	11
Lane Config		LT			LR				12
v (vph)		20			60				
C(m) (vph)		1165			480				
v/c		0.02			0.13				
95% queue length		0.05			0.43				
Control Delay		8.1			13.6				
LOS		A			B				
Approach Delay					13.6				
Approach LOS					B				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		259	18	19	267	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		76	5	5	73	
Hourly Flow Rate, HFR		304	21	20	293	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	43		15			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	11		4			
Hourly Flow Rate, HFR	45		15			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		293
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		325	647		314			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	314	
Potential Capacity	731	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	731	
Probability of Queue free St.	0.98	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	325	
Potential Capacity	1165	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1165	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	647	
Potential Capacity	439	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	431	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 647
Potential Capacity 439
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 431

Results for Two-stage process:
a
y
C t 431

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	45		15			
Movement Capacity (vph)	431		731			
Shared Lane Capacity (vph)		480				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	431		731			
Volume	45		15			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		480				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		20		60				
C(m) (vph)		1165		480				
v/c		0.02		0.13				
95% queue length		0.05		0.43				
Control Delay		8.1		13.6				
LOS		A		B				
Approach Delay				13.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		293
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	250	23	366	1	140	243	135	174	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	713	1712	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	522	1254	0.58	0.42	17.7	B	22.1	C
R	518	1244	0.79	0.42	25.4	C		

Northbound

LTR	708	1700	0.59	0.42	16.9	B	16.9	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	511	1227	0.70	0.42	22.4	C	22.4	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 20.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	250	23	366	1	140	243	135	174	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	69	6	102	1	38	66	39	51	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			304	407		417			360	
%InSharedLn												
Prop LTs		0.036			0.914			0.002			0.436	
Prop RTs		0.250			0.000	1.000		0.633			0.003	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	250	23	366	1	140	243	135	174	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	278	26	407	1	152	264	157	202	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			304 407			417			360		
Prop LTs	0.036			0.914			0.002			0.436		
Prop RTs	0.250			0.000 1.000			0.633			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.915			1.000		
fLT	0.992			0.724			0.999			0.620		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1712			1254 1244			1700			1227		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1712	0.02	0.42	713	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	304	1254	0.24	0.42	522	0.58
Right	R	407	1244	# 0.33	0.42	518	0.79
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	417	1700	0.25	0.42	708	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	360	1227	# 0.29	0.42	511	0.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.04	0.42	10.4	1.000	713	0.50	0.1	0.0	10.5	B	10.5	B
Westbound												
LT	0.58	0.42	13.5	1.000	522	0.50	4.2	0.0	17.7	B	22.1	C
R	0.79	0.42	15.2	1.000	518	0.50	10.2	0.0	25.4	C		
Northbound												
LTR	0.59	0.42	13.5	1.000	708	0.50	3.3	0.0	16.9	B	16.9	B
Southbound												
LTR	0.70	0.42	14.5	1.000	511	0.50	7.9	0.0	22.4	C	22.4	C

Intersection delay = 20.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	278	1	157
Proportion of LT in LT lane group, PLT	0.036	0.914	0.002	0.436
Proportion of LT in opposing flow, PLTo	0.91	0.04	0.44	0.00
Adjusted opposing flow rate, Vo (veh/h)	304	28	360	417
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	4.63	0.02	2.62
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.07	0.47	6.00	6.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	4.61	0.00	5.93	7.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	17.78
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	3.52
PTHo=1-PLTo	0.09	0.96	0.56	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.91	0.00	0.44
EL1 (refer to Exhibit C16-3)	1.89	1.42	2.00	2.12
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	3.51
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00	7.05
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.62
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.724	0.999	0.620

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	4.61		5.93	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.184		0.237	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	304		360	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.5	0.00	0.0	0.0	17.7
R	0.0	0.00	17.5	15.2	0.00	0.0	0.0	25.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.5	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.5	0.00	0.0	0.0	22.4
	0.0						0.0	
Intersection Delay			20.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	28			304	407	417			360			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1712			1254	1244	1700			1227			
LnCapacity	713			522	518	708			511			
Flow Ratio	0.0			0.2	0.3	0.2			0.3			
v/c Ratio	0.04			0.58	0.79	0.59			0.70			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.887		0.931			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.3			3.9	5.9	5.4			5.0			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			0.7	1.6	0.9			1.2			
Q Average	0.3			4.6	7.5	6.3			6.2			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.4			5.7	9.1	7.7			7.6			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.5			
BOQ	0.5			6.9	11.0	9.3			9.2			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.7	1.6	1.6			1.6			
BOQ	0.6			7.8	12.0	10.3			10.1			
QSRatio												
95th Percentile Output:												
fB%	2.5			2.0	1.8	1.9			1.9			
BOQ	0.8			9.1	13.6	11.8			11.7			
QSRatio												
98th Percentile Output:												
fB%	3.1			2.3	2.0	2.1			2.1			
BOQ	0.9			10.5	15.2	13.3			13.2			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: Philip Habib & Associates
 Date: 6/17/13
 Period: Weekday 12-1 PM MD Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				315		3	381			430		
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.56 0.33 19.4 B 19.4 B

Northbound

T 970 1940 0.43 0.50 10.7 B 10.7 B

Southbound

T 946 1892 0.53 0.50 11.4 B 11.4 B

Intersection Delay = 13.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: Philip Habib & Associates
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				315		3	381			430		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				89		1	104			125		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					361		414			500		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				315		3	381			430		
PHF				0.88		0.88	0.92			0.86		
Adj flow				358		3	414			500		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					361			414			500	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
fLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	361	1933	# 0.19	0.33	644	0.56
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	414	1940	0.21	0.50	970	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	500	1892	# 0.26	0.50	946	0.53
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.56	0.33	16.4	1.000	644	0.50	3.0	0.0	19.4	B	19.4	B
Northbound												
T	0.43	0.50	9.5	1.000	970	0.50	1.2	0.0	10.7	B	10.7	B
Southbound												
T	0.53	0.50	10.2	1.000	946	0.50	1.2	0.0	11.4	B	11.4	B

Intersection delay = 13.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.4	0.00	0.0	0.0	19.4
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.5	0.00	0.0	0.0	10.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.2	0.00	0.0	0.0	11.4
	0.0						0.0	
Intersection Delay			13.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		381	234			136	609	
Peak-Hour Factor, PHF		0.92	0.92			0.86	0.86	
Hourly Flow Rate, HFR		414	254			158	708	
Percent Heavy Vehicles		--	--			16	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		158						
C(m) (vph)		859						
v/c		0.18						
95% queue length		0.67						
Control Delay		10.1						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		381	234	136	609	
Peak-Hour Factor, PHF		0.92	0.92	0.86	0.86	
Peak-15 Minute Volume		104	64	40	177	
Hourly Flow Rate, HFR		414	254	158	708	
Percent Heavy Vehicles		--	--	16	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		708
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		668						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	668	
Potential Capacity	859	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	859	
Probability of Queue free St.	0.82	1.00
Maj L-Shared Prob Q free St.	0.68	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.68	0.68
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		158						
C(m) (vph)		859						
v/c		0.18						
95% queue length		0.67						
Control Delay		10.1						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.82
v(i1), Volume for stream 2 or 5		708
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.68
d(M,LT), Delay for stream 1 or 4		10.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		3.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				97		185	417	77		175	416	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 386 1446 0.84 0.27 39.1 D 39.1 D

Northbound

TR 1056 1864 0.51 0.57 9.5 A 9.5 A

Southbound

LT 658 1161 1.04 0.57 50.1 D 50.1 D

Intersection Delay = 33.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				97		185	417	77		175	416	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				28		53	113	21		51	121	
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					324			537			687	
%InSharedLn												
Prop LTs					0.343			0.000			0.295	
Prop RTs					0.657			0.156			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				97		185	417	77		175	416	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				111		213	453	84		203	484	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					324			537			687	
Prop LTs					0.343			0.000			0.295	
Prop RTs					0.657			0.156			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.911			0.979			1.000	
fLT					0.983			1.000			0.598	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1446			1864			1161	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	324	1446	# 0.22	0.27	386	0.84
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	537	1864	0.29	0.57	1056	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	687	1161	# 0.59	0.57	658	1.04
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.82
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.84	0.27	20.8	1.000	386	0.50	18.3	0.0	39.1	D	39.1	D
Northbound												
TR	0.51	0.57	7.9	1.000	1056	0.50	1.5	0.0	9.5	A	9.5	A
Southbound												
LT	1.04	0.57	13.0	1.000	658	0.50	37.1	0.0	50.1	D	50.1	D

Intersection delay = 33.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			203
Proportion of LT in LT lane group, PLT	0.343	0.000	0.295
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			537
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.38
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			5.81
gu=g-gq if gq>=gf, or = g-gf if gq<gf			28.19
n=Max(gq-gf)/2,0)			2.74
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.30
EL1 (refer to Exhibit C16-3)			2.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.60
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.598

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.81
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.171
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				537
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.295
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.657	0.156
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.8	0.00	0.0	0.0	39.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.9	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	7.3	0.0	50.1
	0.0						0.0	
Intersection Delay			33.7	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
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 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	141	63	79	36	172	53	91	551	131	103	438	67
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	433	1258	0.76	0.34	34.1	C	34.1	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	555	1611	0.51	0.34	26.8	C	26.8	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	339	623	0.29	0.54	12.7	B		
TR	1051	1930	0.71	0.54	18.3	B	17.6	B

Southbound

LTR	953	1750	0.70	0.54	19.3	B	19.3	B
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Intersection Delay = 21.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	141	63	79	36	172	53	91	551	131	103	438	67
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	41	18	23	10	47	14	25	151	36	29	123	19
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		329			284		100	749			668	
%InSharedLn												
Prop LTs		0.498			0.137		1.000	0.000			0.174	
Prop RTs		0.280			0.204			0.192			0.090	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	141	63	79	36	172	53	91	551	131	103	438	67
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	164	73	92	39	187	58	100	605	144	116	492	60
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	329			284			100 749			668		
Prop LTs	0.498			0.137			1.000 0.000			0.174		
Prop RTs	0.280			0.204			0.192			0.090		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.962			0.972			0.971			0.987		
fLT	0.625			0.924			0.358 1.000			0.584		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1258			1611			623 1930			1750		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	329	1258	# 0.26	0.34	433	0.76
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	284	1611	0.18	0.34	555	0.51
Right							
Northbound							
Prot							
Perm							
Left	L	100	623	0.16	0.54	339	0.29
Prot							
Perm							
Thru	TR	749	1930	# 0.39	0.54	1051	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	668	1750	0.38	0.54	953	0.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.76	0.34	26.2	1.000	433	0.50	8.0	0.0	34.1	C	34.1	C
Westbound												
LTR	0.51	0.34	23.5	1.000	555	0.50	3.3	0.0	26.8	C	26.8	C
Northbound												
L	0.29	0.54	11.1	1.000	339	0.50	1.6	0.0	12.7	B		
TR	0.71	0.54	15.3	1.000	1051	0.50	3.0	0.0	18.3	B	17.6	B
Southbound												
LTR	0.70	0.54	15.1	1.000	953	0.50	4.2	0.0	19.3	B	19.3	B

Intersection delay = 21.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			100	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.17	
Adjusted opposing flow rate, Vo (veh/h)			668	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.50	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.77	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			4.93	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			44.07	
n=Max(gq-gf)/2,0)			2.46	
PTHo=1-PLTo			0.83	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.51	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.16	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			4.93	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.36	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.358	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	164	39	116
Proportion of LT in LT lane group, PLT	0.498	0.137	0.000
Proportion of LT in opposing flow, PLTo	0.14	0.50	0.00
Adjusted opposing flow rate, Vo (veh/h)	284	329	749
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	4.10	0.98	2.90
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.10	8.23	18.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	8.3	2.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	9.06	10.73	24.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.94	20.27	24.78
n=Max(gq-gf)/2,0)	4.53	1.22	10.92
PTHo=1-PLTo	0.86	0.50	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.50	0.14	0.74
EL1 (refer to Exhibit C16-3)	1.85	1.94	2.93
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.55	1.14	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.07	0.07
gdifff=max(gq-gf,0)	9.06	2.43	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.63	0.92	0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.625	0.924	0.584

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	9.06	10.73	4.93	24.22
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.292	0.346	0.101	0.494
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	284	329	668	749
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.498	0.137	1.000	0.174
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.280	0.204	0.192	0.090
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	26.2	0.00	0.0	0.0 0.0 0.0	34.1
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	23.5	0.00	0.0	0.0 0.0 0.0	26.8
Northbound								
L	0.0	0.00	20.5	11.1	0.00	0.0	0.0	12.7
TR	0.0 0.0	0.00	20.5	15.3	0.00	0.0	0.0 0.0	18.3
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	15.1	0.00	0.0	0.0 0.0 0.0	19.3
Intersection Delay			21.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	329		284		100	749	350	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1258		1611		623	1930	919	
LnCapacity	433		555		339	1051	500	
Flow Ratio	0.3		0.2		0.2	0.4	0.4	
v/c Ratio	0.76		0.51		0.29	0.71	0.70	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.3		5.7		1.4	13.9	6.4	
kB	0.4		0.8		0.4	0.9	0.7	
Q2	1.2		0.8		0.2	2.0	1.5	
Q Average	8.5		6.4		1.5	16.0	7.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	10.4		7.9		1.9	19.2	9.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	12.4		9.5		2.5	22.6	11.6	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.6	
BOQ	13.5		10.5		2.8	24.3	12.7	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.9		2.3	1.6	1.8	
BOQ	15.2		12.1		3.6	26.2	14.3	
QSRatio								
98th Percentile Output:								
fB%	2.0		2.1		2.8	1.8	2.0	
BOQ	16.8		13.6		4.3	28.1	15.9	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	283						745			521		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	662	1986	0.49	0.33	26.4	C	26.4	C

Westbound

Northbound

T 2134 3842 0.38 0.56 11.7 B 11.7 B

Southbound

T 1951 3512 0.30 0.56 11.0 B 11.0 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	283						745			521		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	80						205			146		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	322						819			585		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	283						745			521		
PHF	0.88						0.91			0.89		
Adj flow	322						819			585		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	322						819			585		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.971						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	1986						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	322	1986	# 0.16	0.33	662	0.49
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	819	3842	# 0.21	0.56	2134	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	585	3512	0.17	0.56	1951	0.30
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.38$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.42$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.49	0.33	23.9	1.000	662	0.50	2.5	0.0	26.4	C	26.4	C	
Westbound													
Northbound													
T	0.38	0.56	11.3	1.000	2134	0.50	0.4	0.0	11.7	B	11.7	B	
Southbound													
T	0.30	0.56	10.7	1.000	1951	0.50	0.4	0.0	11.0	B	11.0	B	

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	23.9	0.00	0.0	0.0	26.4
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.3	0.00	0.0	0.0	11.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.7	0.00	0.0	0.0	11.0
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	322						430		307	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.49						0.38		0.30	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.4						6.1		4.1	
kB	0.9						0.9		1.1	
Q2	0.8						0.6		0.5	
Q Average	7.2						6.6		4.6	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	8.8						8.1		5.7	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.6						9.8		7.0	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	11.7						10.8		7.8	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.9		2.0	
BOQ	13.2						12.4		9.2	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.3	
BOQ	14.8						13.9		10.5	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed:
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						521	
Peak-Hour Factor, PHF						0.89	
Hourly Flow Rate, HFR						585	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							87
Peak Hour Factor, PHF							0.84
Hourly Flow Rate, HFR							103
Percent Heavy Vehicles							29
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								103
C(m) (vph)								688
v/c								0.15
95% queue length								0.52
Control Delay								11.2
LOS								B
Approach Delay							11.2	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed:
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					521	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					146	
Hourly Flow Rate, HFR					585	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						87
Peak Hour Factor, PHF						0.84
Peak-15 Minute Volume						26
Hourly Flow Rate, HFR						103
Percent Heavy Vehicles						29
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								292
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		292
Potential Capacity		688
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		688
Probability of Queue free St.	1.00	0.85
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	501
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	501
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	501	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	501	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	561
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	561

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	762	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity	648	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						103
Movement Capacity (vph)						688
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						688
Volume						103
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								103
C(m) (vph)								688
v/c								0.15
95% queue length								0.52
Control Delay								11.2
LOS								B
Approach Delay							11.2	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktow/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	91	221	140	207	578	54	104	89	216	47	40	39
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	157	472	0.69	0.33	45.0	D		
TR	596	1788	0.66	0.33	30.4	C	33.6	C
Westbound								
L	180	541	1.28	0.33	188.6	F		
TR	1126	3379	0.61	0.33	27.4	C	67.8	E
Northbound								
LTR	893	3216	0.49	0.28	29.1	C	29.1	C
Southbound								
L	380	1711	0.16	0.22	29.1	C		
TR	358	1609	0.28	0.22	30.9	C	30.2	C

Intersection Delay = 47.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktow/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	91	221	140	207	578	54	104	89	216	47	40	39
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	27	66	42	58	161	15	28	24	58	15	12	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	108	392		230	688			440		59	99	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.255			0.000	
Prop RTs		0.329			0.067			0.527			0.495	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	91	221	140	207	578	54	104	89	216	47	40	39
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	108	263	129	230	642	46	112	96	232	59	50	49
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	108	392		230	688			440		59	99	
Prop LTs	1.000	0.000		1.000	0.000			0.255			0.000	
Prop RTs		0.329			0.067			0.527			0.495	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.943	0.943		0.962			0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.951			0.990		0.921				0.926	
fLT	0.259	1.000		0.323	1.000		0.987			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	472	1788		541	3379		3216			1711	1609	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	108	472	0.23	0.33	157	0.69
Prot							
Perm							
Thru	TR	392	1788	0.22	0.33	596	0.66
Right							
Westbound							
Prot							
Perm							
Left	L	230	541	# 0.43	0.33	180	1.28
Prot							
Perm							
Thru	TR	688	3379	0.20	0.33	1126	0.61
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	440	3216	# 0.14	0.28	893	0.49
Right							
Southbound							
Prot							
Perm							
Left	L	59	1711	0.03	0.22	380	0.16
Prot							
Perm							
Thru	TR	99	1609	# 0.06	0.22	358	0.28
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.62$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.75$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.69	0.33	26.0	1.000	157	0.50	19.0	0.0	45.0	D		
TR	0.66	0.33	25.6	1.000	596	0.50	4.8	0.0	30.4	C	33.6	C
Westbound												
L	1.28	0.33	30.0	1.000	180	0.50	158.6	0.0	188.6	F		
TR	0.61	0.33	25.1	1.000	1126	0.50	2.3	0.0	27.4	C	67.8	E
Northbound												
LTR	0.49	0.28	27.2	1.000	893	0.50	1.9	0.0	29.1	C	29.1	C
Southbound												
L	0.16	0.22	28.2	1.000	380	0.50	0.9	0.0	29.1	C		
TR	0.28	0.22	29.0	1.000	358	0.50	1.9	0.0	30.9	C	30.2	C

Intersection delay = 47.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	108	230		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	688	392		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/3600	2.70	5.75		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.03	9.80		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.07	11.70		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.93	18.30		
n=Max(gq-gf)/2,0)	5.04	5.85		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.56	1.89		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.32		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.259	0.323		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.255 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.07			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.336			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	688			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.067
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	26.0	0.00	0.0	0.0	45.0
TR	0.0	0.00	30.0	25.6	0.00	0.0	0.0	30.4
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	12.5	0.0	188.6
TR	0.0	0.00	30.0	25.1	0.00	0.0	0.0	27.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	27.2	0.00	0.0	0.0	29.1
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	29.1
TR	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.9
	0.0						0.0	

Intersection Delay	47.9	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	108	392		230	361		231			59	99	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	472	1788		541	1774		1689			1711	1609	
LnCapacity	157	596		180	591		469			380	358	
Flow Ratio	0.2	0.2		0.4	0.2		0.1			0.0	0.1	
v/c Ratio	0.69	0.66		1.28	0.61		0.49			0.16	0.28	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.3	8.4		5.8	7.6		4.8			1.2	2.1	
kB	0.3	0.7		0.3	0.7		0.7			0.6	0.5	
Q2	0.5	1.2		7.5	1.1		0.6			0.1	0.2	
Q Average	2.9	9.6		13.2	8.7		5.5			1.3	2.3	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	3.6	11.7		16.0	10.5		6.7			1.7	2.9	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.4	1.5		1.5			1.6	1.6	
BOQ	4.5	13.9		18.8	12.6		8.2			2.1	3.6	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.5	1.6		1.7			1.9	1.8	
BOQ	5.1	15.1		20.3	13.8		9.1			2.4	4.1	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.7		1.7	1.8		1.9			2.4	2.2	
BOQ	6.2	16.8		22.1	15.4		10.6			3.1	5.1	
QSRatio												
98th Percentile Output:												
fB%	2.5	1.9		1.8	2.0		2.2			2.9	2.7	
BOQ	7.3	18.5		23.9	17.0		12.0			3.7	6.0	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed:
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						387			
Peak-Hour Factor, PHF						0.87			
Hourly Flow Rate, HFR						444			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		130							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		139							
Percent Heavy Vehicles		4							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			139							
C(m) (vph)			568							
v/c			0.24							
95% queue length			0.96							
Control Delay			13.4							
LOS			B							
Approach Delay				13.4						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed:
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 387
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 111
 Hourly Flow Rate, HFR 444
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 130
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 35
 Hourly Flow Rate, HFR 139
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			444					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	444	
Potential Capacity	568	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	568	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 444
Potential Capacity 568
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 568

Results for Two-stage process:
a
y
C t 568

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	139					
Movement Capacity (vph)	568					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	568					
Volume	139					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			139					
C(m) (vph)			568					
v/c			0.24					
95% queue length			0.96					
Control Delay			13.4					
LOS			B					
Approach Delay				13.4				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	85	31	126	89	0	39	0	40	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.88	0.88	0.90	0.90	0.78	0.78		
Flow Rate	47	83	188	50	50	51		
% Heavy Veh	42	42	4	4	3	3		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	47	83	188	50	50	51		
Left-Turn	0	0	140	0	50	0		
Right-Turn	0	35	0	0	0	51		
Prop. Left-Turns	0.0	0.0	0.7	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	60	117	279	219	385	18	242	151	86	22	302	219
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 818 3200 0.66 0.26 33.8 C 33.8 C

Westbound

LTR 878 3437 0.79 0.26 37.8 D 37.8 D

Northbound

DefL 189 585 1.47 0.32 268.9 F
 TR 581 1802 0.47 0.32 27.1 C 149.1 F

Southbound

LTR 837 2598 0.72 0.32 32.2 C 32.2 C

Intersection Delay = 61.2 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60	117	279	219	385	18	242	151	86	22	302	219
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	35	83	61	107	5	70	43	25	6	84	61
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		542			691		278	273			603	
%InSharedLn												
Prop LTs		0.131			0.352		1.000	0.000			0.040	
Prop RTs		0.613			0.029			0.363			0.403	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60	117	279	219	385	18	242	151	86	22	302	219
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	71	139	332	243	428	20	278	174	99	24	336	243
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	542			691			278 273			603		
Prop LTs	0.131			0.352			1.000 0.000			0.040		
Prop RTs	0.613			0.029			0.363			0.403		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.908			0.996			0.946			0.940		
fLT	0.993			0.983			0.307 1.000			0.934		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3200			3437			585 1802			2598		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	542	3200	# 0.17	0.26	818	0.66
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	691	3437	# 0.20	0.26	878	0.79
Right							
Northbound							
Prot							
Perm							
Left	DefL	278	585	# 0.48	0.32	189	1.47
Prot							
Perm							
Thru	TR	273	1802	0.15	0.32	581	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	2598	0.23	0.32	837	0.72
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.85
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.01

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.66	0.26	30.0	1.000	818	0.50	3.7	0.0	33.8	C	33.8	C	
Westbound													
LTR	0.79	0.26	31.2	1.000	878	0.50	6.6	0.0	37.8	D	37.8	D	
Northbound													
DefL	1.47	0.32	30.5	1.000	189	0.50	238.4	0.0	268.9	F			
TR	0.47	0.32	24.4	1.000	581	0.50	2.7	0.0	27.1	C	149.1	F	
Southbound													
LTR	0.72	0.32	26.9	1.000	837	0.50	5.3	0.0	32.2	C	32.2	C	

Intersection delay = 61.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			278	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			603	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.95	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.92	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			8.02	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			20.98	
n=Max(gq-gf)/2,0)			4.01	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.36	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.78	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			8.02	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.31	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.307	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	24
Proportion of LT in LT lane group, PLT	0.131 0.352 0.000 0.040
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	273
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.60
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.41
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.01
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.27
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	1.83
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdif=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.01
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				273
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.040
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.613	0.029	0.363
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	30.0	0.00	0.0	0.0 0.0 0.0	33.8
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	31.2	0.00	0.0	0.0 0.0 0.0	37.8
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	22.3	0.0	268.9
TR	0.0 0.0	0.00	30.5	24.4	0.00	0.0	0.0 0.0	27.1
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	26.9	0.00	0.0	0.0 0.0 0.0	32.2
Intersection Delay			61.2	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	284		362		278	273	316	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1680		1805		585	1802	1364	
LnCapacity	429		461		189	581	439	
Flow Ratio	0.2		0.2		0.5	0.2	0.2	
v/c Ratio	0.66		0.79		1.47	0.47	0.72	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.889		0.932			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.4		8.4		6.9	5.5	7.0	
kB	0.6		0.6		0.4	0.8	0.6	
Q2	1.0		2.0		12.1	0.7	1.5	
Q Average	7.4		10.4		19.1	6.1	8.5	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	9.1		12.6		23.0	7.5	10.3	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.4	1.5	1.5	
BOQ	10.9		14.9		26.9	9.1	12.3	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.5	1.6	1.6	
BOQ	11.9		16.2		28.8	10.1	13.5	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.7		1.6	1.9	1.8	
BOQ	13.5		17.9		31.0	11.6	15.1	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.9		1.7	2.1	2.0	
BOQ	15.1		19.6		33.1	13.1	16.7	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 No-Action Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	658	367	3	1	390	427	0	0	1	84	0	130
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	783	1711	0.92	0.71	34.3	C		
TR	1158	1628	0.35	0.71	5.6	A	24.0	C
Westbound								
LT	451	1843	0.95	0.24	55.3	E	103.4	F
R	383	1568	1.22	0.24	147.5	F		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.37	0.18	37.1	D		
LT	320	1801	0.00	0.18	30.4	C	18.6	B
R	952	1478	0.14	0.64	6.6	A		

Intersection Delay = 55.2 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	658	367	3	1	390	427	0	0	1	84	0	130
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	181	101	1	1	107	117	0	0	1	22	0	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	723	406			430	469		4		87	0	134
%InSharedLn										0		
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	658	367	3	1	390	427	0	0	1	84	0	130
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	723	403	3	1	429	469	0	0	4	87	0	134
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	723	406			430	469		4		87	0	134
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.980	0.980		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.865				1.000	0.850
fLT	0.950	1.000		0.999			1.000			0.755	1.000	
Sec.	0.148											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1711	1628		1843	1568		1844			1313	1801	1478
Sec.	267											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		703	1711	# 0.41	0.411	703	1.00
Perm		20	267	0.07	0.300	80	0.25
Left	L	723			0.71	783	0.92
Prot							
Perm							
Thru	TR	406	1628	0.25	0.71	1158	0.35
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	430	1843	0.23	0.24	451	0.95
Right	R	469	1568	# 0.30	0.24	383	1.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	87	1313	# 0.07	0.18	233	0.37
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	134	1478	0.09	0.64	952	0.14

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.93

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.92	0.71	19.9	1.000	783	0.50	14.4	0.0	34.3	C			
TR	0.35	0.71	5.0	1.000	1158	0.50	0.6	0.0	5.6	A	24.0	C	
Westbound													
LT	0.95	0.24	33.5	1.000	451	0.50	21.8	0.0	55.3	E	103.4	F	
R	1.22	0.24	34.0	1.000	383	0.50	113.5	0.0	147.5	F			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.37	0.18	32.6	1.000	233	0.50	4.5	0.0	37.1	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	18.6	B	

R 0.14 0.64 6.3 1.000 952 0.50 0.3 0.0 6.6 A

Intersection delay = 55.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	723			87
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	430			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.08			2.17
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.75			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	21.34			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	5.66			16.00
n=Max(gq-gf)/2,0)	10.67			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.95			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	10.55			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	21.34			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	406	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.15	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		2.09	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdifff=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		406		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.007
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	723			
v/c ratio from Capacity Worksheet, X	0.92			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	21.34			
Unopposed green interval, gu	5.66			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.35			
XPerm	2.71			
XProt	0.72			
Case	3			
Queue at beginning of green arrow, Qa	8.64			
Queue at beginning of unsaturated green, Qu	4.29			
Residual queue, Qr	3.42			
Uniform Delay, d1	19.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		19.9	0.00	0.0	0.0	34.3
TR	0.0	0.00	13.0	5.0	0.00	0.0	0.0	5.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	33.5	0.00	0.0	0.0	55.3
R	0.0	0.00	34.0	34.0	0.00	21.5	0.0	147.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.6	0.00	0.0	0.0	37.1
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.6
Intersection Delay			55.2	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	723	406		430	469	4		87	0	134
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1102	1628		1843	1568	1844		1313	1801	1478
LnCapacity	783	1158		451	383	328		233	320	952
Flow Ratio	0.7	0.2		0.2	0.3	0.0		0.1	0.0	0.1
v/c Ratio	0.92	0.35		0.95	1.22	0.01		0.37	0.00	0.14
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	8.4	3.9		10.6	11.7	0.1		1.9	0.0	1.3
kB	0.7	0.9		0.4	0.3	0.5		0.4	0.5	1.1
Q2	5.1	0.5		3.3	12.3	0.0		0.2	0.0	0.2
Q Average	13.5	4.4		13.9	24.0	0.1		2.2	0.0	1.5
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	16.3	5.5		16.7	28.8	0.1		2.7	0.0	1.9
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4	1.7		1.6	1.7	1.6
BOQ	19.2	6.7		19.7	33.7	0.2		3.4	0.0	2.4
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5	2.0		1.8	2.0	1.9
BOQ	20.7	7.5		21.2	36.1	0.2		3.9	0.0	2.8
QSRatio										
95th Percentile Output:										
fB%	1.7	2.0		1.7	1.6	2.6		2.2	2.6	2.3
BOQ	22.5	8.9		23.0	38.6	0.2		4.9	0.0	3.5
QSRatio										
98th Percentile Output:										
fB%	1.8	2.3		1.8	1.7	3.2		2.7	3.2	2.8
BOQ	24.3	10.2		24.8	41.1	0.3		5.8	0.0	4.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2015 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	415	36	0	2	62	69	4	3	0	62	6	752
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	709	1418	0.64	0.50	20.9	C		
TR	1056	2111	0.04	0.50	11.5	B	20.1	C

LT	541	1390	0.14	0.39	18.3	B	33.7	C
R	593	1524	0.83	0.39	36.1	D		

Intersection Delay = 25.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	415	36	0	2	62	69	4	3	0	62	6	752
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	114	10	0	1	17	19	2	1	0	17	2	209
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	456	40			127		7	5			76	491
%InSharedLn												
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908	
Prop RTs		0.000			0.449			0.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0	0	0	0	
Buses	0	0			0		0	0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	415	36	0	2	62	69	4	3	0	62	6	752
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	456	40	0	2	68	57	7	5	0	69	7	491
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	456	40			127		7	5			76	491
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908	
Prop RTs		0.000			0.449			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.933				1.000		1.000	0.850	
fLT	0.672	1.000		0.954			0.708	1.000		0.775		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1418	2111		3072			1331	1881		1390	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	456	1418	# 0.32	0.50	709	0.64
Prot							
Perm							
Thru	TR	40	2111	0.02	0.50	1056	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	127	3072	0.04	0.50	1536	0.08
Right							
Northbound							
Prot							
Perm							
Left	DefL	7	1331	0.01	0.39	518	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	76	1390	0.05	0.39	541	0.14
Right	R	491	1524	# 0.32	0.39	593	0.83

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.64$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.72$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.64	0.50	16.6	1.000	709	0.50	4.3	0.0	20.9	C		
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	20.1	C
Westbound												
LTR	0.08	0.50	11.7	1.000	1536	0.50	0.1	0.0	11.8	B	11.8	B
Northbound												
DefL	0.01	0.39	16.9	1.000	518	0.50	0.0	0.0	16.9	B		
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.14	0.39	17.8	1.000	541	0.50	0.5	0.0	18.3	B	33.7	C

R 0.83 0.39 24.8 1.000 593 0.50 11.3 0.0 36.1 D

Intersection delay = 25.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	456		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	127		76	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	11.40		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.67		1.90	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.41	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.672		0.708	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	69
Proportion of LT in LT lane group, PLT	0.000	0.016 0.000 0.908
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	40	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.73
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.50
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.775

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	127	40	76	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.016	1.000	0.908
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.449	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	16.6	0.00	0.0	0.0	20.9
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.7	0.00	0.0	0.0	11.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	27.5	24.8	0.00	0.0	0.0	36.1
Intersection Delay			25.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	456	40			66		7	5		76	491	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1418	2111			1613		1331	1881		1390	1524	
LnCapacity	709	1056			806		518	732		541	593	
Flow Ratio	0.3	0.0			0.0		0.0	0.0		0.1	0.3	
v/c Ratio	0.64	0.04			0.08		0.01	0.01		0.14	0.83	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	8.4	0.5			0.9		0.1	0.1		1.2	11.1	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	1.5	0.0			0.1		0.0	0.0		0.1	2.8	
Q Average	9.9	0.6			0.9		0.1	0.1		1.3	13.8	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	12.0	0.7			1.2		0.2	0.1		1.7	16.7	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	14.3	0.9			1.6		0.2	0.1		2.2	19.6	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	15.5	1.1			1.8		0.2	0.2		2.5	21.2	
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.4		2.6	2.6		2.4	1.7	
BOQ	17.2	1.4			2.3		0.3	0.2		3.2	23.0	
QSRatio												
98th Percentile Output:												
fB%	1.9	3.0			2.9		3.2	3.2		2.8	1.8	
BOQ	18.9	1.7			2.8		0.4	0.3		3.8	24.8	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	142		24				4	221		598	376	
Lane Width	13.0		12.0					11.5		16.0		
RTOR Vol			6								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.30	0.32	16.9	B	16.6	B
R	465	1468	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1660 3212 0.15 0.52 7.8 A 7.8 A

Southbound

TR 1957 3787 0.62 0.52 11.4 B 11.4 B

Intersection Delay = 11.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	142		24				4	221		598	376	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	40		7				1	61		187	117	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	161		20					250			1217	
%InSharedLn												
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.386	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975						0.998			0.686	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	142		24				4	221		598	376	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	161		20				4	246		747	470	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	161		20					250			1217	
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.386	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.909	0.909			0.962		0.980	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.942	
fLT	0.950				0.939		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1696	1468			3212		3787	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	161	1696	# 0.09	0.32	537	0.30
Prot							
Perm							
Thru							
Right	R	20	1468	0.01	0.32	465	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	250	3212	0.08	0.52	1660	0.15
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1217	3787	# 0.32	0.52	1957	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.30	0.32	15.5	1.000	537	0.50	1.4	0.0	16.9	B	16.6	B	
R	0.04	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B			
Westbound													
Northbound													
LT	0.15	0.52	7.6	1.000	1660	0.50	0.2	0.0	7.8	A	7.8	A	
Southbound													
TR	0.62	0.52	10.3	1.000	1957	0.50	1.0	0.0	11.4	B	11.4	B	

Intersection delay = 11.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.016 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1217
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	10.97
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	4.86
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.939

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.97	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.354	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1217	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.016	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.386
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.5	0.00	0.0	0.0	16.9
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.6	0.00	0.0	0.0	7.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	10.3	0.00	0.0	0.0	11.4
	0.0						0.0	
Intersection Delay			11.4	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	161	20				131		639	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1696	1468				1686		1988	
LnCapacity	537	465				871		1027	
Flow Ratio	0.1	0.0				0.1		0.3	
v/c Ratio	0.30	0.04				0.15		0.62	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	2.0	0.2				1.1		7.6	
kB	0.5	0.5				0.8		0.6	
Q2	0.2	0.0				0.1		1.0	
Q Average	2.3	0.3				1.3		8.6	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.9	0.3				1.6		10.4	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.5	
BOQ	3.6	0.4				2.1		12.4	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	4.1	0.5				2.4		13.6	
QSRatio									
95th Percentile Output:									
fB%	2.2	2.6				2.4		1.8	
BOQ	5.0	0.6				3.0		15.2	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.1				2.9		2.0	
BOQ	6.0	0.8				3.7		16.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Volume	1	0		544	1		1			22	429	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	612	1468	0.47	0.42	15.2	B		
LT	587	1408	0.49	0.42	15.7	B	15.4	B

Northbound

L	287	689	0.00	0.42	10.2	B	10.2	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2039	4893	0.28	0.42	11.9	B	11.9	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		544	1		1			22	429	0
% Heavy Veh	1	1		1	1		1			2	2	2
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol	1	0		143	1		1			7	134	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			287	287		1			563		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.998		1.000				0.048	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.989		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		544	1		1			22	429	0
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	4	0		573	1		1			27	536	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			287	287		1			563		
Prop LTs	0.000			1.000 0.998			1.000			0.048		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.724		0.393		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1468 1408		689		4893	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	287	1468	0.20	0.42	612	0.47
Prot							
Perm							
Thru	LT	287	1408	# 0.20	0.42	587	0.49
Right							
Northbound							
Prot							
Perm							
Left	L	1	689	0.00	0.42	287	0.00
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	563	4893	# 0.12	0.42	2039	0.28
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.47	0.42	12.7	1.000	612	0.50	2.5	0.0	15.2	B			
LT	0.49	0.42	12.8	1.000	587	0.50	2.8	0.0	15.7	B	15.4	B	
Northbound													
L	0.00	0.42	10.2	1.000	287	0.50	0.0	0.0	10.2	B	10.2	B	
Southbound													
LTR	0.28	0.42	11.5	1.000	2039	0.50	0.3	0.0	11.9	B	11.9	B	

Intersection delay = 13.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		287	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.05	
Adjusted opposing flow rate, Vo (veh/h)		4	563	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.78	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.44	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	2.16	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	22.84	
n=Max(gq-gf)/2,0)		0.00	1.08	
PTHo=1-PLTo		1.00	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.33	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.08	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	2.16	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.39	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.393	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	286		
Proportion of LT in LT lane group, PLT	0.000	0.998	0.048
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.77		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.724		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		287	287	1		206	
So	1900		1900	1900	1900		1900	
No.Lanes	0	1	0	1	0	0	0	3
SL	1881		1468	1408	689		1796	
LnCapacity	784		612	587	287		748	
Flow Ratio	0.0		0.2	0.2	0.0		0.1	
v/c Ratio	0.01		0.47	0.49	0.00		0.28	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.983		0.989	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.5	3.5	0.0		2.3	
kB	0.7		0.6	0.6	0.4		0.7	
Q2	0.0		0.5	0.5	0.0		0.3	
Q Average	0.0		4.0	4.1	0.0		2.5	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.3	
BOQ	0.1		5.0	5.0	0.0		3.2	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.6	
BOQ	0.1		6.1	6.2	0.0		4.0	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.8	
BOQ	0.1		6.9	7.0	0.0		4.6	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.0	2.6		2.2	
BOQ	0.1		8.2	8.3	0.0		5.6	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.4	3.2		2.6	
BOQ	0.1		9.5	9.6	0.0		6.6	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	23
Peak-Hour Factor, PHF	0.55
Hourly Flow Rate, HFR	41
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	361
Peak Hour Factor, PHF	0.90
Hourly Flow Rate, HFR	401
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	401
C(m) (vph)	1033
v/c	0.39
95% queue length	1.86
Control Delay	10.7
LOS	B
Approach Delay	10.7
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.55				
Peak-15 Minute Volume		10				
Hourly Flow Rate, HFR		41				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			361			
Peak Hour Factor, PHF			0.90			
Peak-15 Minute Volume			100			
Hourly Flow Rate, HFR			401			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					41			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	41	
Potential Capacity	1033	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1033	
Probability of Queue free St.	0.61	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.61
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.61
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			401			
Movement Capacity (vph)			1033			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1033			
Volume			401			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					401			
C(m) (vph)					1033			
v/c					0.39			
95% queue length					1.86			
Control Delay					10.7			
LOS					B			
Approach Delay				10.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	53	30	130	57	0	0	0	0	30	76	20
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.86		0.77				0.80 0.80	
Flow Rate	95		242				84 71	
% Heavy Veh	17		4				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	95		242				84	71
Left-Turn	0		168				37	0
Right-Turn	34		0				0	24
Prop. Left-Turns	0.0		0.7				0.4	0.0
Prop. Right-Turns	0.4		0.0				0.0	0.3
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	39	45	0	0	146	22	41	61	86	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	97		217		80		132	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	97		217		80	132		
Left-Turn	45		0		46	0		
Right-Turn	0		28		0	97		
Prop. Left-Turns	0.5		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

Worksheet 4 - Departure Headway and Service Time

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	145	130	109	2	37	5	508	37	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	551	1575	0.55	0.35	19.6	B	18.5	B
R	560	1599	0.11	0.35	13.6	B		

Westbound

LTR	531	1516	0.09	0.35	13.4	B	13.4	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2287	4731	0.25	0.48	9.3	A	9.3	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 13.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	145	130	109	2	37	5	508	37	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	40	36	30	1	10	2	131	10	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		302	63		46			564				
%InSharedLn												
Prop LTs		0.526			0.043			0.929				
Prop RTs		0.000	1.000		0.109			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	145	130	109	2	37	5	508	37	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	159	143	63	2	39	5	524	38	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	302 63			46			564					
Prop LTs	0.526			0.043			0.929					
Prop RTs	0.000 1.000			0.109			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.952			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.985			0.999	
fLT	0.810			0.988			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1575	1599		1516			4731	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.55	0.35	15.7	1.000	551	0.50	3.9	0.0	19.6	B	18.5	B
R	0.11	0.35	13.2	1.000	560	0.50	0.4	0.0	13.6	B		
Westbound												
LTR	0.09	0.35	13.1	1.000	531	0.50	0.3	0.0	13.4	B	13.4	B
Northbound												
LTR	0.25	0.48	9.1	1.000	2287	0.50	0.3	0.0	9.3	A	9.3	A
Southbound												

Intersection delay = 13.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	159	2	
Proportion of LT in LT lane group, PLT	0.526	0.043	0.929
Proportion of LT in opposing flow, PLTo	0.04	0.53	
Adjusted opposing flow rate, Vo (veh/h)	46	302	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.65	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	5.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	5.72	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.96	0.47	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.53	0.04	
EL1 (refer to Exhibit C16-3)	1.44	1.89	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.810	0.988	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	5.72		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.273		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	46	302	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.526	0.043	0.929	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.109	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	15.7	0.00	0.0	0.0	19.6
R	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.1	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			13.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound		
LaneGroup	LT	R	LTR	LTR				
Init Queue	0.0	0.0	0.0	0.0				
Flow Rate	302	63	46	207				
So	1900	1900	1900	1900				
No.Lanes	0 1	1	0 1	0 3	0	0	0	0
SL	1575	1599	1516	1736				
LnCapacity	551	560	531	839				
Flow Ratio	0.2	0.0	0.0	0.1				
v/c Ratio	0.55	0.11	0.09	0.25				
Grn Ratio	0.35	0.35	0.35	0.48				
I Factor	0.999		0.999	0.980				
AT or PVG	3	3	3	3				
Pltn Ratio	1.00	1.00	1.00	1.00				
PF2	1.00	1.00	1.00	1.00				
Q1	4.0	0.7	0.5	2.0				
kB	0.6	0.6	0.6	0.7				
Q2	0.7	0.1	0.1	0.2				
Q Average	4.7	0.8	0.6	2.3				
Q Spacing	25.0	25.0	25.0	25.0				
Q Storage	0	0	0	0				
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3	1.3				
BOQ	5.8	1.0	0.7	2.9				
QSRatio								
85th Percentile Output:								
fB%	1.5	1.7	1.7	1.6				
BOQ	7.2	1.3	0.9	3.6				
QSRatio								
90th Percentile Output:								
fB%	1.7	1.9	1.9	1.8				
BOQ	8.0	1.5	1.1	4.1				
QSRatio								
95th Percentile Output:								
fB%	2.0	2.5	2.5	2.2				
BOQ	9.4	1.9	1.4	5.1				
QSRatio								
98th Percentile Output:								
fB%	2.3	3.0	3.0	2.7				
BOQ	10.8	2.3	1.7	6.0				
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	93		39				14	283		333	31	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 461 1730 0.35 0.27 19.9 B 19.9 B

Westbound

Northbound

LT 1092 1927 0.31 0.57 7.6 A 7.6 A

Southbound

TR 1173 2070 0.34 0.57 7.7 A 7.7 A

Intersection Delay = 9.9 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93		39				14	283		333	31	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	29		12				4	81		91	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		163						341			400	
%InSharedLn												
Prop LTs		0.706						0.047			0.000	
Prop RTs		0.294						0.000			0.085	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	93		39				14	283		333	31	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	115		48				16	325		366	34	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		163						341			400	
Prop LTs		0.706						0.047			0.000	
Prop RTs	0.294						0.000			0.085		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.960						1.000			0.989		
fLT	0.966						0.978			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1730						1927			2070		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	163	1730	# 0.09	0.27	461	0.35
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	341	1927	0.18	0.57	1092	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	400	2070	# 0.19	0.57	1173	0.34
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.29

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.34

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.35	0.27	17.8	1.000	461	0.50	2.1	0.0	19.9	B	19.9	B
Westbound												
Northbound												
LT	0.31	0.57	6.8	1.000	1092	0.50	0.7	0.0	7.6	A	7.6	A
Southbound												
TR	0.34	0.57	7.0	1.000	1173	0.50	0.8	0.0	7.7	A	7.7	A

Intersection delay = 9.9 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		16	
Proportion of LT in LT lane group, PLT	0.706	0.047	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		400	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.27	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.67	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		3.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.62	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.08	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.978	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			3.64	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.107	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			400	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.047	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.085
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	17.8	0.00	0.0	0.0	19.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	6.8	0.00	0.0	0.0	7.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.0	0.00	0.0	0.0	7.7
	0.0						0.0	
Intersection Delay			9.9	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	163						341			400		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1730						1927			2070		
LnCapacity	461						1092			1173		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.35						0.31			0.34		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.2						3.0			3.6		
kB	0.5						0.9			0.9		
Q2	0.3						0.4			0.5		
Q Average	2.5						3.4			4.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.3			1.2		
BOQ	3.1						4.2			5.0		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.6			1.5		
BOQ	3.9						5.3			6.2		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.8			1.7		
BOQ	4.4						5.9			7.0		
QSRatio												
95th Percentile Output:												
fB%	2.2						2.1			2.0		
BOQ	5.4						7.1			8.3		
QSRatio												
98th Percentile Output:												
fB%	2.6						2.5			2.4		
BOQ	6.4						8.3			9.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrotts Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	78		52				43	333		282	125	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 555 1664 0.27 0.33 15.9 B 15.9 B

Westbound

Northbound

LT 843 1685 0.51 0.50 12.1 B 12.1 B

Southbound

TR 1017 2034 0.42 0.50 10.8 B 10.8 B

Intersection Delay = 12.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	78		52				43	333		282	125	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	23		15				12	96		77	34	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		151						432			432	
%InSharedLn												
Prop LTs		0.603						0.113			0.000	
Prop RTs		0.397						0.000			0.282	
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	78		52				43	333		282	125	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	91		60				49	383		310	122	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		151						432			432	
Prop LTs		0.603						0.113			0.000	
Prop RTs		0.397						0.000			0.282	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.946						1.000			0.962		
fLT	0.971						0.920			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1664						1685			2034		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	151	1664	# 0.09	0.33	555	0.27
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	432	1685	# 0.26	0.50	843	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	432	2034	0.21	0.50	1017	0.42
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.27	0.33	14.7	1.000	555	0.50	1.2	0.0	15.9	B	15.9	B
Westbound												
Northbound												
LT	0.51	0.50	10.1	1.000	843	0.50	2.0	0.0	12.1	B	12.1	B
Southbound												
TR	0.42	0.50	9.5	1.000	1017	0.50	1.2	0.0	10.8	B	10.8	B

Intersection delay = 12.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
gu=g-gq if gq>=gf, or = g-gf if gq<gf
n=Max(gq-gf)/2,0)
PTHo=1-PLTo
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]
EL1 (refer to Exhibit C16-3)
EL2=Max((1-Ptho**n)/Plto, 1.0)
fmin=2(1+PL)/g or fmin=2(1+Pl)/g
gdifff=max(gq-gf,0)
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)
or flt=[fm+0.91(N-1)]/N**
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		49	
Proportion of LT in LT lane group, PLT	0.603	0.113	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		432	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.82	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.20	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		5.66	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.93	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.11	
EL1 (refer to Exhibit C16-3)		2.15	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.920	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			5.66	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.189	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		432	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.603		0.113	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.397	0.282
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	14.7	0.00	0.0	0.0 0.0 0.0	15.9
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	10.1	0.00	0.0	0.0 0.0 0.0	12.1
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	9.5	0.00	0.0	0.0 0.0 0.0	10.8
Intersection Delay			12.1	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	151						432			432		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1664						1685			2034		
LnCapacity	555						843			1017		
Flow Ratio	0.1						0.3			0.2		
v/c Ratio	0.27						0.51			0.42		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.8						4.8			4.6		
kB	0.6						0.7			0.8		
Q2	0.2						0.7			0.6		
Q Average	2.1						5.6			5.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.6						6.8			6.4		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.3						8.3			7.8		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.7			1.7		
BOQ	3.8						9.2			8.7		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			2.0		
BOQ	4.6						10.7			10.1		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.2			2.2		
BOQ	5.5						12.2			11.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	9		102	222	455	123	61	164		341	31	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.05	0.13	23.1	C	33.2	C
R	220	1652	0.60	0.13	34.2	C		
Westbound								
LTR	1339	4727	0.69	0.28	21.2	C	21.2	C
Northbound								
L	171	514	0.40	0.33	21.9	C		
T	593	1778	0.31	0.33	16.1	B	17.7	B
Southbound								
TR	690	2071	0.60	0.33	19.8	B	19.8	B

Intersection Delay = 21.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9		102	222	455	123	61	164		341	31	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		33	64	131	35	17	46		95	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	12		132		919		69	184			413	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000			0.082	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9		102	222	455	123	61	164		341	31	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	12		132	255	523	141	69	184		379	34	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	12		132		919		69	184			413	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000			0.082	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.943	0.943	0.980	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.977			1.000	0.989	
fLT	0.950		0.986		0.287	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4727		514	1778	2071	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	12	1668	0.01	0.13	222	0.05
Prot							
Perm							
Thru							
Right	R	132	1652	# 0.08	0.13	220	0.60
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	919	4727	# 0.19	0.28	1339	0.69
Right							
Northbound							
Prot							
Perm							
Left	L	69	514	0.13	0.33	171	0.40
Prot							
Perm							
Thru	T	184	1778	0.10	0.33	593	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	413	2071	# 0.20	0.33	690	0.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.47
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.05	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	33.2	C	
R	0.60	0.13	24.5	1.000	220	0.50	9.7	0.0	34.2	C			
Westbound													
LTR	0.69	0.28	19.1	1.000	1339	0.50	2.1	0.0	21.2	C	21.2	C	
Northbound													
L	0.40	0.33	15.4	1.000	171	0.50	6.5	0.0	21.9	C	17.7	B	
T	0.31	0.33	14.9	1.000	593	0.50	1.3	0.0	16.1	B			
Southbound													
TR	0.60	0.33	16.7	1.000	690	0.50	3.1	0.0	19.8	B	19.8	B	

Intersection delay = 21.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			69	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			413	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.15	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.88	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			8.98	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.02	
n=Max(gq-gf)/2,0)			4.49	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.92	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.287	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			8.98	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.449	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			413	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.153	0.082
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	24.5	0.00	0.0	0.0	34.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.1	0.00	0.0	0.0	21.2
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.4	0.00	0.0	0.0	21.9
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.7	0.00	0.0	0.0	19.8
	0.0						0.0	
Intersection Delay			21.4	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	12	132		337		69	184		413
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1735		514	1778		2071
LnCapacity	222	220		491		171	593		690
Flow Ratio	0.0	0.1		0.2		0.1	0.1		0.2
v/c Ratio	0.05	0.60		0.69		0.40	0.31		0.60
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	2.1		5.0		0.9	2.3		5.7
kB	0.2	0.2		0.4		0.2	0.6		0.5
Q2	0.0	0.4		0.8		0.2	0.3		0.8
Q Average	0.2	2.4		5.8		1.0	2.5		6.5
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.2	3.1		7.1		1.3	3.2		8.0
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.5
BOQ	0.3	3.9		8.7		1.7	4.0		9.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.7		1.9	1.8		1.6
BOQ	0.4	4.4		9.6		2.0	4.6		10.7
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		1.9		2.4	2.2		1.9
BOQ	0.5	5.4		11.1		2.5	5.6		12.2
QSRatio									
98th Percentile Output:									
fB%	3.1	2.6		2.2		2.9	2.6		2.1
BOQ	0.6	6.4		12.6		3.0	6.6		13.7
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	15	7				6	220	109	222	415	27
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 456 1611 0.09 0.28 16.2 B 16.2 B

Westbound

Northbound

LTR 920 1673 0.41 0.55 9.1 A 9.1 A

Southbound

L 560 1018 0.44 0.55 10.0- A
 TR 1017 1849 0.48 0.55 9.6 A 9.7 A

Intersection Delay = 9.7 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	15	7				6	220	109	222	415	27
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	62	31	62	115	8
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		43						376		247	491	
%InSharedLn												
Prop LTs		0.186						0.019		1.000	0.000	
Prop RTs		0.256						0.324			0.061	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	15	7				6	220	109	222	415	27
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	8	24	11				7	247	122	247	461	30
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	43						376			247	491	
Prop LTs	0.186						0.019			1.000	0.000	
Prop RTs	0.256						0.324			0.061		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW	1.033							1.133			1.000	1.000
fHV	0.980							0.943			0.990	0.990
fG	1.000							1.000			1.000	1.000
fP	0.875							0.875			1.000	1.000
fBB	1.000							0.992			1.000	0.992
fA	1.000							1.000			1.000	1.000
fLU	1.000							1.000			1.000	1.000
fRT	0.965							0.956				0.991
fLT	0.991							0.992			0.541	1.000
Sec.												
fLpb	1.000							1.000			1.000	1.000
fRpb	1.000							1.000				1.000
S	1611							1673			1018	1849
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	43	1611	# 0.03	0.28	456	0.09
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	376	1673	0.22	0.55	920	0.41
Right							
Southbound							
Prot							
Perm							
Left	L	247	1018	0.24	0.55	560	0.44
Prot							
Perm							
Thru	TR	491	1849	# 0.27	0.55	1017	0.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.29
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.35

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.28	15.8	1.000	456	0.50	0.4	0.0	16.2	B	16.2	B
Westbound												
Northbound												
LTR	0.41	0.55	7.8	1.000	920	0.50	1.3	0.0	9.1	A	9.1	A
Southbound												
L	0.44	0.55	8.0	1.000	560	0.50	2.0	0.0	10.0-	A		
TR	0.48	0.55	8.3	1.000	1017	0.50	1.3	0.0	9.6	A	9.7	A

Intersection delay = 9.7 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				247
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				376
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.12
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.27
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.58
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.42
n=Max(gq-gf)/2,0)				1.79
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.86
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.78
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.58
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.541

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		7	
Proportion of LT in LT lane group, PLT	0.186	0.019	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		491	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.12	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.18	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		5.51	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.28	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			5.51	3.58
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.167	0.108
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			491	376
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.019	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.256	0.324	0.061
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.8	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.8	0.00	0.0	0.0	9.1
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.0	0.00	0.0	0.0	10.0-
TR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	9.6
	0.0						0.0	

Intersection Delay	9.7	sec/veh	Intersection LOS	A
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		43						376			247	491
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1611						1673			1018	1849
LnCapacity		456						920			560	1017
Flow Ratio		0.0						0.2			0.2	0.3
v/c Ratio		0.09						0.41			0.44	0.48
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.932				0.785
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.5						3.6			2.4	5.0
kB		0.5						0.8			0.4	0.7
Q2		0.1						0.5			0.4	0.6
Q Average		0.6						4.2			2.8	5.6
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.3	1.2
BOQ		0.7						5.2			3.5	7.0
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.6	1.5
BOQ		1.0						6.4			4.4	8.5
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.8	1.7
BOQ		1.1						7.1			5.0	9.4
QSRatio												
95th Percentile Output:												
fB%		2.5						2.0			2.2	1.9
BOQ		1.4						8.5			6.1	10.9
QSRatio												
98th Percentile Output:												
fB%		3.0						2.4			2.6	2.2
BOQ		1.8						9.8			7.2	12.3
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	5	7	17	257	25	102	21	228	165	87	316	19
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	626	1408	0.06	0.44	14.4	B	14.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	548	1232	0.56	0.44	21.9	C		
T	763	1717	0.04	0.44	14.2	B	19.8	B
R	563	1266	0.21	0.44	16.1	B		

Northbound

LTR	688	1547	0.68	0.44	23.3	C	23.3	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	642	1444	0.73	0.44	25.3	C	25.3	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 22.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	7	17	257	25	102	21	228	165	87	316	19
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	2	5	76	7	30	6	64	46	24	88	5
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		37		306	30	121		465			469	
%InSharedLn												
Prop LTs		0.162		1.000	0.000			0.052			0.207	
Prop RTs		0.595			0.000	1.000		0.398			0.045	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.830			0.650			0.650	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	7	17	257	25	102	21	228	165	87	316	19
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	9	22	306	30	121	24	256	185	97	351	21
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	37			306	30	121	465			469		
Prop LTs	0.162			1.000	0.000		0.052			0.207		
Prop RTs	0.595			0.000 1.000			0.398			0.045		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound	
LG	LTR		L	T	R	LTR		LTR	
So	1900		1900	1900	1900	1900		1900	
Lanes	0	1	0	1	1	0	1	0	0
fW	1.000		1.000	0.967	0.967	0.967		1.000	
fHV	0.980		0.935	0.935	0.935	0.943		0.980	
fG	1.000		1.000	1.000	1.000	1.000		1.000	
fP	0.875		1.000	1.000	0.875	1.000		1.000	
fBB	0.992		1.000	1.000	0.992	1.000		1.000	
fA	1.000		1.000	1.000	1.000	1.000		1.000	
fLU	1.000		1.000	1.000	1.000	1.000		1.000	
fRT	0.920		1.000		0.850	0.946		0.994	
fLT	0.979		0.733	1.000		0.965		0.784	
Sec.									
fLpb	1.000		0.947	1.000		1.000		0.995	
fRpb	0.967		1.000		1.000	0.978		1.000	
S	1408		1232	1717	1266	1547		1444	
Sec.									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	37	1408	0.03	0.44	626	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	306	1232	# 0.25	0.44	548	0.56
Prot							
Perm							
Thru	T	30	1717	0.02	0.44	763	0.04
Right	R	121	1266	0.10	0.44	563	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	465	1547	0.30	0.44	688	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	469	1444	# 0.32	0.44	642	0.73
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	626	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.56	0.44	18.5	1.000	548	0.50	3.4	0.0	21.9	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	19.8	B
R	0.21	0.44	15.4	1.000	563	0.50	0.7	0.0	16.1	B		
Northbound												
LTR	0.68	0.44	19.9	1.000	688	0.50	3.5	0.0	23.3	C	23.3	C
Southbound												
LTR	0.73	0.44	20.6	1.000	642	0.50	4.8	0.0	25.3	C	25.3	C

Intersection delay = 22.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		37		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.733		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	6	24	97
Proportion of LT in LT lane group, PLT	0.162	0.000	0.052
Proportion of LT in opposing flow, PLTo	0.00	0.21	0.05
Adjusted opposing flow rate, Vo (veh/h)	30	469	465
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.15	0.60	2.42
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.75	11.73	11.63
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	16.4	3.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	12.29	12.18
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	23.56	27.82
n=Max(gq-gf)/2,0)	0.00	0.00	4.13
PTHo=1-PLTo	1.00	0.79	0.95
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.05	0.21
EL1 (refer to Exhibit C16-3)	1.42	2.23	2.22
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	3.81
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	8.26
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.96	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.979	0.965	0.784

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	12.29	12.18
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.307	0.304
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	30	37	469	465
OCCr	0.000	0.053	0.000	0.025
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.975
Proportion of left turns, PLT	0.162	1.000	0.052	0.207
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.995
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.595	1.000	0.398	0.045
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.967	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.4
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.5	0.00	0.0	0.0	21.9
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.4	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	19.9	0.00	0.0	0.0	23.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.6	0.00	0.0	0.0	25.3
	0.0						0.0	
Intersection Delay			22.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	37		306	30	121	465		469	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1408		1232	1717	1266	1547		1444	
LnCapacity	626		548	763	563	688		642	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.3	
v/c Ratio	0.06		0.56	0.04	0.21	0.68		0.73	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.830			0.650		0.650	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.5		5.7	0.4	1.9	9.2		9.6	
kB	0.8		0.6	0.8	0.6	0.6		0.5	
Q2	0.1		0.8	0.0	0.2	1.1		1.4	
Q Average	0.6		6.4	0.5	2.0	10.4		11.0	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	0.7		7.9	0.6	2.6	12.6		13.4	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	1.0		9.5	0.8	3.2	14.9		15.8	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.6		1.6	
BOQ	1.1		10.5	0.9	3.7	16.2		17.2	
QSRatio									
95th Percentile Output:									
fB%	2.5		1.9	2.5	2.3	1.7		1.7	
BOQ	1.4		12.0	1.1	4.6	17.9		18.9	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.9		1.9	
BOQ	1.8		13.6	1.4	5.5	19.6		20.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 No-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	150		182	75		172	185		74			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	914	1828	0.35	0.50	14.7	B	14.7	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	756	1512	0.36	0.50	15.0	B	15.0	B
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Northbound

LR	569	1463	0.52	0.39	24.1	C	24.1	C
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Southbound

Intersection Delay = 17.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		150	182	75	172		185		74			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		42	51	21	47		53		21			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		320			271			294				
%InSharedLn												
Prop LTs		0.000			0.303			0.714				
Prop RTs		0.478			0.000			0.286				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		150	182	75	172		185		74			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		167	153	82	189		210		84			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		320			271			294				
Prop LTs		0.000			0.303			0.714				
Prop RTs		0.478			0.000			0.286				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.935			1.000			0.961					
fLT	1.000			0.814			0.966					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1828			1512			1463					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 17.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	82		
Proportion of LT in LT lane group, PLT	0.000	0.303	0.714
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	320		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	2.05		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.00		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	6.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	6.55		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	38.34		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.30		
EL1 (refer to Exhibit C16-3)	1.92		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.814		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
TR	0.0						0.0	
	0.0	0.00	22.5	13.6	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
LT	0.0						0.0	
	0.0	0.00	22.5	13.7	0.00	0.0	0.0	15.0
	0.0						0.0	
Northbound								
LR	0.0						0.0	
	0.0	0.00	27.5	21.0	0.00	0.0	0.0	24.1
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			17.9	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		320			271			294				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1828			1512			1463				
LnCapacity		914			756			569				
Flow Ratio		0.2			0.2			0.2				
v/c Ratio		0.35			0.36			0.52				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		4.8			4.1			5.6				
kB		1.0			0.9			0.7				
Q2		0.6			0.5			0.7				
Q Average		5.4			4.6			6.4				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		6.7			5.8			7.8				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		8.1			7.0			9.4				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.7			1.6				
BOQ		9.0			7.9			10.4				
QSRatio												
95th Percentile Output:												
fB%		1.9			2.0			1.9				
BOQ		10.5			9.3			12.0				
QSRatio												
98th Percentile Output:												
fB%		2.2			2.3			2.1				
BOQ		11.9			10.6			13.5				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	33	18	28	55	17	33	28	207	66	56	206	27
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 230 1968 0.40 0.12 29.7 C 29.7 C

Westbound

LTR 497 1989 0.26 0.25 19.3 B 19.3 B

Northbound

LTR 708 1848 0.49 0.38 16.4 B 16.4 B

Southbound

LTR 655 1708 0.54 0.38 17.6 B 17.6 B

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	33	18	28	55	17	33	28	207	66	56	206	27
% Heavy Veh	2	2	2	1	1	1	6	6	6	9	9	9
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
PK 15 Vol	10	5	8	17	5	10	8	59	19	17	64	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		92			130			346			356	
%InSharedLn												
Prop LTs		0.413			0.523			0.092			0.194	
Prop RTs		0.359			0.315			0.220			0.093	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	33	18	28	55	17	33	28	207	66	56	206	27
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
Adj flow	38	21	33	68	21	41	32	238	76	69	254	33
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	92			130			346			356		
Prop LTs	0.413			0.523			0.092			0.194		
Prop RTs	0.359			0.315			0.220			0.093		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.980			0.990			0.943			0.917		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.952			0.957			0.970			0.987		
fLT	0.980			0.975			0.945			0.882		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1968			1989			1848			1708		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	92	1968	# 0.05	0.12	230	0.40
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	130	1989	# 0.07	0.25	497	0.26
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	346	1848	0.19	0.38	708	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	356	1708	# 0.21	0.38	655	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.43

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.40	0.12	24.6	1.000	230	0.50	5.1	0.0	29.7	C	29.7	C	
Westbound													
LTR	0.26	0.25	18.1	1.000	497	0.50	1.3	0.0	19.3	B	19.3	B	
Northbound													
LTR	0.49	0.38	14.0	1.000	708	0.50	2.4	0.0	16.4	B	16.4	B	
Southbound													
LTR	0.54	0.38	14.4	1.000	655	0.50	3.2	0.0	17.6	B	17.6	B	

Intersection delay = 18.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			32	69
Proportion of LT in LT lane group, PLT	0.413	0.523	0.092	0.194
Proportion of LT in opposing flow, PLTo			0.19	0.09
Adjusted opposing flow rate, Vo (veh/h)			356	346
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.53	1.15
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.93	5.77
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.9	4.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			6.49	6.25
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.11	16.75
n=Max(gq-gf)/2,0)			0.00	1.13
PTHo=1-PLTo			0.81	0.91
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.09	0.19
EL1 (refer to Exhibit C16-3)			1.99	1.97
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.12
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			0.00	2.25
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.945	0.882

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.25
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.272
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				346
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.194
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.359	0.220
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	29.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.1	0.00	0.0	0.0	19.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.0	0.00	0.0	0.0	16.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.4	0.00	0.0	0.0	17.6
	0.0						0.0	
Intersection Delay			18.6	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			LTR			LTR			LTR		
Init Queue	0.0			0.0			0.0			0.0		
Flow Rate	92			130			346			356		
So	1900			1900			1900			1900		
No.Lanes	0	1	0	0	1	0	0	1	0	0	1	0
SL	1968			1989			1848			1708		
LnCapacity	230			497			708			655		
Flow Ratio	0.0			0.1			0.2			0.2		
v/c Ratio	0.40			0.26			0.49			0.54		
Grn Ratio	0.12			0.25			0.38			0.38		
I Factor	1.000			1.000			1.000			1.000		
AT or PVG	3			3			3			3		
Pltn Ratio	1.00			1.00			1.00			1.00		
PF2	1.00			1.00			1.00			1.00		
Q1	1.4			1.7			4.4			4.6		
kB	0.3			0.5			0.7			0.6		
Q2	0.2			0.2			0.6			0.7		
Q Average	1.6			1.9			5.0			5.4		
Q Spacing	25.0			25.0			25.0			25.0		
Q Storage	0			0			0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.3			1.2			1.2		
BOQ	2.1			2.4			6.2			6.6		
QSRatio												
85th Percentile Output:												
fB%	1.6			1.6			1.5			1.5		
BOQ	2.6			3.1			7.6			8.1		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.8			1.7			1.7		
BOQ	3.0			3.5			8.4			9.0		
QSRatio												
95th Percentile Output:												
fB%	2.3			2.3			2.0			1.9		
BOQ	3.8			4.4			9.9			10.4		
QSRatio												
98th Percentile Output:												
fB%	2.8			2.7			2.3			2.2		
BOQ	4.5			5.2			11.3			11.9		
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			276	18		14	277	
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81	
Hourly Flow Rate, HFR			317	20		17	341	
Percent Heavy Vehicles			--	--		7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		28		26				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		41		38				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10
Lane Config		LT			LR			
v (vph)		17			79			
C(m) (vph)		1195			497			
v/c		0.01			0.16			
95% queue length		0.04			0.56			
Control Delay		8.1			13.6			
LOS		A			B			
Approach Delay					13.6			
Approach LOS					B			

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		276	18	14	277	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		79	5	4	85	
Hourly Flow Rate, HFR		317	20	17	341	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	28		26			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	10		10			
Hourly Flow Rate, HFR	41		38			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		341
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		337	702		327			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	327	
Potential Capacity	703	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	703	
Probability of Queue free St.	0.95	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	337	
Potential Capacity	1195	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1195	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	702	
Potential Capacity	397	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.93
Movement Capacity	391	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor 1.00 1.00
 Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
 Movement Capacity

Result for 2 stage process:
 a
 y
 C t
 Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows 702
 Potential Capacity 397
 Pedestrian Impedance Factor 1.00 1.00
 Maj. L, Min T Impedance factor 0.98
 Maj. L, Min T Adj. Imp Factor. 0.99
 Cap. Adj. factor due to Impeding mvmnt 0.99 0.93
 Movement Capacity 391

Results for Two-stage process:
 a
 y
 C t 391

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	41		38			
Movement Capacity (vph)	391		703			
Shared Lane Capacity (vph)		497				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	391		703			
Volume	41		38			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		497				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		17		79				
C(m) (vph)		1195		497				
v/c		0.01		0.16				
95% queue length		0.04		0.56				
Control Delay		8.1		13.6				
LOS		A		B				
Approach Delay				13.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		341
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	10	2	310	20	241	4	136	291	182	236	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	723	1736	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	531	1275	0.76	0.42	24.0	C	21.2	C
R	523	1256	0.56	0.42	17.4	B		

Northbound

LTR	742	1780	0.62	0.42	17.4	B	17.4	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	482	1157	1.01	0.42	61.1	E	61.1	E
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 31.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	10	2	310	20	241	4	136	291	182	236	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	95	6	73	1	37	78	53	69	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		14			402	294		463			487	
%InSharedLn												
Prop LTs		0.071			0.940			0.009			0.435	
Prop RTs		0.143			0.000	1.000		0.676			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	10	2	310	20	241	4	136	291	182	236	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	11	2	378	24	294	4	146	313	212	274	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	14			402 294			463			487		
Prop LTs	0.071			0.940			0.009			0.435		
Prop RTs	0.143			0.000 1.000			0.676			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.981			1.000 0.850			0.909			1.000		
fLT	0.982			0.729			0.996			0.580		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1736			1275 1256			1780			1157		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	14	1736	0.01	0.42	723	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	402	1275	# 0.32	0.42	531	0.76
Right	R	294	1256	0.23	0.42	523	0.56
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	463	1780	0.26	0.42	742	0.62
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	487	1157	# 0.42	0.42	482	1.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	723	0.50	0.0	0.0	10.3	B	10.3	B	
Westbound													
LT	0.76	0.42	14.9	1.000	531	0.50	9.1	0.0	24.0	C	21.2	C	
R	0.56	0.42	13.3	1.000	523	0.50	4.0	0.0	17.4	B			
Northbound													
LTR	0.62	0.42	13.8	1.000	742	0.50	3.6	0.0	17.4	B	17.4	B	
Southbound													
LTR	1.01	0.42	17.5	1.000	482	0.50	43.6	0.0	61.1	E	61.1	E	

Intersection delay = 31.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	378	4	212
Proportion of LT in LT lane group, PLT	0.071	0.940	0.009	0.435
Proportion of LT in opposing flow, PLTo	0.94	0.07	0.44	0.01
Adjusted opposing flow rate, Vo (veh/h)	402	14	487	463
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	6.30	0.07	3.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.70	0.23	8.12	7.72
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	6.89	0.00	8.76	8.24
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	16.76
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.12
PTHo=1-PLTo	0.06	0.93	0.56	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07	0.94	0.01	0.44
EL1 (refer to Exhibit C16-3)	2.09	1.40	2.27	2.22
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.06
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00	8.24
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.58
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.729	0.996	0.580

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	6.89		8.76	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.276		0.350	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	402		487	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.071		0.009	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.9	0.00	0.0	0.0	24.0
R	0.0	0.00	17.5	13.3	0.00	0.0	0.0	17.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.8	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	1.3	0.0	61.1
	0.0						0.0	
Intersection Delay			31.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	14			402	294	463			487			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1736			1275	1256	1780			1157			
LnCapacity	723			531	523	742			482			
Flow Ratio	0.0			0.3	0.2	0.3			0.4			
v/c Ratio	0.02			0.76	0.56	0.62			1.01			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.933		0.919			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			5.7	3.7	6.1			8.1			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			1.5	0.6	1.0			5.9			
Q Average	0.2			7.2	4.4	7.1			14.0			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			8.8	5.4	8.7			16.9			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.4			
BOQ	0.3			10.6	6.7	10.5			19.9			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.7	1.6			1.5			
BOQ	0.3			11.6	7.5	11.5			21.5			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.8	2.0	1.8			1.7			
BOQ	0.4			13.2	8.8	13.1			23.3			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.1	2.3	2.1			1.8			
BOQ	0.5			14.8	10.2	14.7			25.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				449		4		427			548	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.81 0.33 22.2 C 22.2 C

Northbound

T 1026 2051 0.45 0.50 11.0 B 11.0 B

Southbound

T 954 1907 0.67 0.50 12.5 B 12.5 B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				449		4	427			548		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				134		1	115			159		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					540		459			637		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				449		4	427			548		
PHF				0.84		0.84	0.93			0.86		
Adj flow				535		5	459			637		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					540			459			637	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	540	2009	# 0.27	0.33	670	0.81
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	459	2051	0.22	0.50	1026	0.45
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	637	1907	# 0.33	0.50	954	0.67
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.60

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.81	0.33	18.2	1.000	670	0.50	4.0	0.0	22.2	C	22.2	C	
Northbound													
T	0.45	0.50	9.7	1.000	1026	0.50	1.3	0.0	11.0	B	11.0	B	
Southbound													
T	0.67	0.50	11.3	1.000	954	0.50	1.3	0.0	12.5	B	12.5	B	

Intersection delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT
 WBLT
 NBLT
 SBLT

Cycle length, C
 60.0
 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.2	0.00	0.0	0.0	22.2
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.7	0.00	0.0	0.0	11.0
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.3	0.00	0.0	0.0	12.5
	0.0						0.0	
Intersection Delay			15.3	sec/veh	Intersection LOS			B

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		427	254	182	815	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		115	68	53	237	
Hourly Flow Rate, HFR		459	273	211	947	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		947
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		732						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	732	
Potential Capacity	804	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	804	
Probability of Queue free St.	0.74	1.00
Maj L-Shared Prob Q free St.	0.41	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.41	0.41
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.74	0.74
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		211						
C(m) (vph)		804						
v/c		0.26						
95% queue length		1.05						
Control Delay		11.1						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.74
v(i1), Volume for stream 2 or 5		947
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.41
d(M,LT), Delay for stream 1 or 4		11.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		6.6

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				130		149	519	101		124	675	
Lane Width				12.0			15.0			15.0		
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 398 1493 0.83 0.27 37.5 D 37.5 D

Northbound

TR 1096 1934 0.61 0.57 10.6 B 10.6 B

Southbound

LT 763 1346 1.22 0.57 112.4 F 112.4 F

Intersection Delay = 64.3 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				130		149	519	101		124	675	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				39		44	140	27		36	196	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					332			667			929	
%InSharedLn												
Prop LTs					0.467			0.000			0.155	
Prop RTs					0.533			0.163			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				130		149	519	101		124	675	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				155		177	558	109		144	785	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					332			667			929	
Prop LTs					0.467			0.000			0.155	
Prop RTs					0.533			0.163			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.928			0.978			1.000	
fLT					0.977			1.000			0.688	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1493			1934			1346	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	332	1493	# 0.22	0.27	398	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	667	1934	0.34	0.57	1096	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	929	1346	# 0.69	0.57	763	1.22
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.10

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.83	0.27	20.7	1.000	398	0.50	16.7	0.0	37.5	D	37.5	D
Northbound												
TR	0.61	0.57	8.6	1.000	1096	0.50	2.0	0.0	10.6	B	10.6	B
Southbound												
LT	1.22	0.57	13.0	1.000	763	0.50	99.4	0.0	112.4	F	112.4	F

Intersection delay = 64.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			144
Proportion of LT in LT lane group, PLT	0.467	0.000	0.155
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			667
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.12
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			2.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.76
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.24
n=Max(gq-gf)/2,0)			2.55
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.16
EL1 (refer to Exhibit C16-3)			2.71
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.69
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.688

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.76
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.228
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				667
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.155
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.533	0.163
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.7	0.00	0.0	0.0	37.5
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.6	0.00	0.0	0.0	10.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	41.5	0.0	112.4
	0.0						0.0	
Intersection Delay			64.3	sec/veh	Intersection LOS		E	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	94	44	109	33	188	51	64	540	104	116	514	49
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	460	1335	0.61	0.34	27.5	C	27.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	567	1647	0.59	0.34	28.8	C	28.8	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	297	545	0.24	0.54	12.2	B		
TR	1066	1958	0.66	0.54	17.1	B	16.7	B

Southbound

LTR	999	1835	0.77	0.54	21.6	C	21.6	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 21.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	94	44	109	33	188	51	64	540	104	116	514	49
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
PK 15 Vol	27	13	31	10	58	16	18	148	29	33	148	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		281			336		70	707			769	
%InSharedLn												
Prop LTs		0.381			0.122		1.000	0.000			0.173	
Prop RTs		0.441			0.188			0.161			0.059	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	94	44	109	33	188	51	64	540	104	116	514	49
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
Adj flow	107	50	124	41	232	63	70	593	114	133	591	45
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	281			336			70 707			769		
Prop LTs	0.381			0.122			1.000 0.000			0.173		
Prop RTs	0.441			0.188			0.161			0.059		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.940			0.975			0.976			0.991		
fLT	0.666			0.933			0.310 1.000			0.586		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1335			1647			545 1958			1835		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	281	1335	# 0.21	0.34	460	0.61
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	336	1647	0.20	0.34	567	0.59
Right							
Northbound							
Prot							
Perm							
Left	L	70	545	0.13	0.54	297	0.24
Prot							
Perm							
Thru	TR	707	1958	0.36	0.54	1066	0.66
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	769	1835	# 0.42	0.54	999	0.77
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.61	0.34	24.5	1.000	460	0.50	3.0	0.0	27.5	C	27.5	C
Westbound												
LTR	0.59	0.34	24.3	1.000	567	0.50	4.5	0.0	28.8	C	28.8	C
Northbound												
L	0.24	0.54	10.7	1.000	297	0.50	1.4	0.0	12.2	B		
TR	0.66	0.54	14.6	1.000	1066	0.50	2.5	0.0	17.1	B	16.7	B
Southbound												
LTR	0.77	0.54	16.1	1.000	999	0.50	5.5	0.0	21.6	C	21.6	C

Intersection delay = 21.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			70	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.17	
Adjusted opposing flow rate, Vo (veh/h)			769	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.75	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.10	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			6.86	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.14	
n=Max(gq-gf)/2,0)			3.43	
PTHo=1-PLTo			0.83	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.77	
EL2=Max((1-Ptho**n)/Plto, 1.0)			2.77	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			6.86	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.31	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.310	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	107	41	133
Proportion of LT in LT lane group, PLT	0.381	0.122	0.000
Proportion of LT in opposing flow, PLTo	0.12	0.38	0.00
Adjusted opposing flow rate, Vo (veh/h)	336	281	707
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.67	1.02	3.33
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.40	7.03	17.67
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.3	7.9	1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	10.99	8.95	21.52
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.01	22.05	27.48
n=Max(gq-gf)/2,0)	4.85	0.50	10.22
PTHo=1-PLTo	0.88	0.62	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.38	0.12	0.74
EL1 (refer to Exhibit C16-3)	1.95	1.85	2.82
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.84	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.07
gdifff=max(gq-gf,0)	9.71	1.01	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67	0.93	0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.666	0.933	0.586

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	10.99	8.95	6.86	21.52
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.354	0.289	0.140	0.439
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	336	281	769	707
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.381	0.122	1.000	0.173
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.441	0.188	0.161	0.059
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.5	0.00	0.0	0.0 0.0 0.0	27.5
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.3	0.00	0.0	0.0 0.0 0.0	28.8
Northbound								
L	0.0	0.00	20.5	10.7	0.00	0.0	0.0	12.2
TR	0.0 0.0	0.00	20.5	14.6	0.00	0.0	0.0 0.0	17.1
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	16.1	0.00	0.0	0.0 0.0 0.0	21.6
Intersection Delay			21.7	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	281		336		70	707	403	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1335		1647		545	1958	963	
LnCapacity	460		567		297	1066	524	
Flow Ratio	0.2		0.2		0.1	0.4	0.4	
v/c Ratio	0.61		0.59		0.24	0.66	0.77	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	5.8		6.9		0.9	12.6	7.9	
kB	0.3		0.8		0.4	0.9	0.7	
Q2	0.5		1.1		0.1	1.8	2.0	
Q Average	6.3		8.0		1.0	14.4	9.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	7.8		9.8		1.3	17.3	12.1	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.4	
BOQ	9.4		11.7		1.7	20.3	14.3	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.6	
BOQ	10.4		12.8		2.0	21.9	15.6	
QSRatio								
95th Percentile Output:								
fB%	1.9		1.8		2.4	1.7	1.7	
BOQ	11.9		14.4		2.5	23.8	17.3	
QSRatio								
98th Percentile Output:								
fB%	2.1		2.0		2.9	1.8	1.9	
BOQ	13.5		16.0		3.0	25.6	18.9	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	368						686			610		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	675	2025	0.60	0.33	28.9	C	28.9	C

Westbound

Northbound

T 2156 3880 0.35 0.56 11.4 B 11.4 B

Southbound

T 1990 3582 0.35 0.56 11.5 B 11.5 B

Intersection Delay = 15.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	368						686			610		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	101						191			175		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	404						762			701		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	368						686			610		
PHF	0.91						0.90			0.87		
Adj flow	404						762			701		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	404						762			701		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2025						3880			3582		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	404	2025	# 0.20	0.33	675	0.60
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm	T	762	3880	# 0.20	0.56	2156	0.35
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm	T	701	3582	0.20	0.56	1990	0.35
Thru							
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.40$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.45$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.60	0.33	25.0	1.000	675	0.50	3.9	0.0	28.9	C	28.9	C	
Westbound													
Northbound													
T	0.35	0.56	11.1	1.000	2156	0.50	0.4	0.0	11.4	B	11.4	B	
Southbound													
T	0.35	0.56	11.1	1.000	1990	0.50	0.5	0.0	11.5	B	11.5	B	

Intersection delay = 15.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	404						400		368	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.60						0.35		0.35	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.4						5.5		5.1	
kB	0.9						1.0		1.1	
Q2	1.2						0.5		0.6	
Q Average	9.7						6.1		5.7	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	11.7						7.4		7.0	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	13.9						9.0		8.5	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	15.2						10.0		9.4	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.9		1.9	
BOQ	16.9						11.5		10.9	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.2	
BOQ	18.5						13.0		12.4	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 N0-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						610	
Peak-Hour Factor, PHF						0.87	
Hourly Flow Rate, HFR						701	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							69
Peak Hour Factor, PHF							0.78
Hourly Flow Rate, HFR							88
Percent Heavy Vehicles							55
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound	
	1	4	7	8	9	10	11
Lane Config							12
							R
v (vph)							88
C(m) (vph)							588
v/c							0.15
95% queue length							0.52
Control Delay							12.2
LOS							B
Approach Delay						12.2	
Approach LOS						B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 NO-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 610
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 175
 Hourly Flow Rate, HFR 701
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 69
 Peak Hour Factor, PHF 0.78
 Peak-15 Minute Volume 22
 Hourly Flow Rate, HFR 88
 Percent Heavy Vehicles 55
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								350
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		350
Potential Capacity		588
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		588
Probability of Queue free St.	1.00	0.85
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	444
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	444
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	444	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	444	900

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	496
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	496

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						588
Volume						88
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								88
C(m) (vph)								588
v/c								0.15
95% queue length								0.52
Control Delay								12.2
LOS								B
Approach Delay							12.2	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2015 No-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	105	247	195	239	486	43	107	57	141	45	43	54
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	181	542	0.66	0.33	38.0	D		
TR	592	1775	0.76	0.33	33.2	C	34.2	C
Westbound								
L	240	696	1.11	0.34	118.2	F		
TR	1154	3350	0.55	0.34	25.6	C	53.1	D
Northbound								
LTR	913	3286	0.33	0.28	26.8	C	26.8	C
Southbound								
L	384	1728	0.15	0.22	29.0	C		
TR	367	1650	0.26	0.22	30.5	C	30.0	C

Intersection Delay = 41.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	105	247	195	239	486	43	107	57	141	45	43	54
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	30	70	55	66	148	13	29	15	38	15	14	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	119	451		266	632			301		59	95	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.382			0.000	
Prop RTs		0.377			0.062			0.415			0.400	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	105	247	195	239	486	43	107	57	141	45	43	54
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	119	281	170	266	593	39	115	61	125	59	57	38
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L TR			L TR			LTR			L TR		
Adj flow	119	451		266	632		301			59	95	
Prop LTs	1.000	0.000		1.000	0.000		0.382			0.000		
Prop RTs	0.377			0.062			0.415			0.400		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.943			0.991		0.938				0.940	
fLT	0.298	1.000		0.409	1.000		0.981			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	542	1775		696	3350		3286			1728	1650	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	119	542	0.22	0.33	181	0.66
Prot							
Perm							
Thru	TR	451	1775	0.25	0.33	592	0.76
Right							
Westbound							
Prot							
Perm							
Left	L	266	696	# 0.38	0.34	240	1.11
Prot							
Perm							
Thru	TR	632	3350	0.19	0.34	1154	0.55
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	301	3286	# 0.09	0.28	913	0.33
Right							
Southbound							
Prot							
Perm							
Left	L	59	1728	0.03	0.22	384	0.15
Prot							
Perm							
Thru	TR	95	1650	# 0.06	0.22	367	0.26
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.66	0.33	25.6	1.000	181	0.50	12.4	0.0	38.0	D			
TR	0.76	0.33	26.8	1.000	592	0.50	6.4	0.0	33.2	C	34.2	C	
Westbound													
L	1.11	0.34	29.5	1.000	240	0.50	88.7	0.0	118.2	F			
TR	0.55	0.34	23.8	1.000	1154	0.50	1.8	0.0	25.6	C	53.1	D	
Northbound													
LTR	0.33	0.28	25.8	1.000	913	0.50	1.0	0.0	26.8	C	26.8	C	
Southbound													
L	0.15	0.22	28.2	1.000	384	0.50	0.8	0.0	29.0	C			
TR	0.26	0.22	28.9	1.000	367	0.50	1.7	0.0	30.5	C	30.0	C	

Intersection delay = 41.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	119	266		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	632	451		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/3600	2.98	6.65		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.30	11.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	8.34	16.06		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.66	14.94		
n=Max(gq-gf)/2,0)	4.17	8.03		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.42	1.99		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30	0.24		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.298	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.382 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 $EL1$ (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	8.34			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.278			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	632			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.062
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	25.6	0.00	0.0	0.0	38.0
TR	0.0	0.00	30.0	26.8	0.00	0.0	0.0	33.2
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	6.5	0.0	118.2
TR	0.0	0.00	29.5	23.8	0.00	0.0	0.0	25.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	25.8	0.00	0.0	0.0	26.8
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	29.0
TR	0.0	0.00	35.0	28.9	0.00	0.0	0.0	30.5
	0.0						0.0	

Intersection Delay	41.5	sec/veh	Intersection LOS	D
--------------------	------	---------	------------------	---

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	119	451		266	331		158			59	95	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	542	1775		696	1759		1725			1728	1650	
LnCapacity	181	592		240	606		479			384	367	
Flow Ratio	0.2	0.3		0.4	0.2		0.1			0.0	0.1	
v/c Ratio	0.66	0.76		1.11	0.55		0.33			0.15	0.26	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.5	10.1		6.7	6.7		3.1			1.2	2.0	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.4	1.6		5.6	0.9		0.3			0.1	0.2	
Q Average	3.0	11.7		12.3	7.6		3.5			1.3	2.2	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	3.7	14.2		14.8	9.3		4.3			1.6	2.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.4	1.5		1.5			1.6	1.6	
BOQ	4.7	16.7		17.5	11.1		5.4			2.1	3.4	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5		1.5	1.6		1.7			1.9	1.8	
BOQ	5.3	18.1		18.9	12.2		6.1			2.4	3.9	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.7		1.7	1.8		2.1			2.4	2.3	
BOQ	6.4	19.8		20.7	13.8		7.3			3.1	4.8	
QSRatio												
98th Percentile Output:												
fB%	2.5	1.8		1.8	2.0		2.4			2.9	2.7	
BOQ	7.5	21.6		22.4	15.4		8.5			3.7	5.8	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						477		
Peak-Hour Factor, PHF						0.89		
Hourly Flow Rate, HFR						535		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		396						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		425						
Percent Heavy Vehicles		3						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			425						
C(m) (vph)			504						
v/c			0.84						
95% queue length			8.62						
Control Delay			39.8						
LOS			E						
Approach Delay				39.8					
Approach LOS				E					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 477
 Peak-Hour Factor, PHF 0.89
 Peak-15 Minute Volume 134
 Hourly Flow Rate, HFR 535
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 396
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 106
 Hourly Flow Rate, HFR 425
 Percent Heavy Vehicles 3
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			535					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	535	
Potential Capacity	504	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	504	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 535
Potential Capacity 504
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 504

Results for Two-stage process:
a
y
C t 504

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	425					
Movement Capacity (vph)	504					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	504					
Volume	425					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			425					
C(m) (vph)			504					
v/c			0.84					
95% queue length			8.62					
Control Delay			39.8					
LOS			E					
Approach Delay				39.8				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	98	28	143	129	0	12	0	67	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.87	0.87	0.91	0.91	0.76	0.76		
Flow Rate	56	88	227	71	15	88		
% Heavy Veh	7	7	1	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	56	88	227	71	15	88		
Left-Turn	0	0	157	0	15	0		
Right-Turn	0	32	0	0	0	88		
Prop. Left-Turns	0.0	0.0	0.7	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	51	131	226	232	437	9	218	99	121	21	304	120
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	826	3232	0.56	0.26	31.6	C	31.6	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	889	3480	0.93	0.26	49.1	D	49.1	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	252	782	0.93	0.32	70.4	E		
TR	575	1783	0.41	0.32	26.0	C	48.1	D

Southbound

LTR	938	2912	0.50	0.32	26.6	C	26.6	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 40.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	51	131	226	232	437	9	218	99	121	21	304	120
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	14	37	64	71	133	3	59	27	33	6	81	32
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		464			827		234	236			473	
%InSharedLn												
Prop LTs		0.125			0.342		1.000	0.000			0.047	
Prop RTs		0.554			0.013			0.551			0.271	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	51	131	226	232	437	9	218	99	121	21	304	120
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	58	149	257	283	533	11	234	106	130	22	323	128
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	464			827			234 236			473		
Prop LTs	0.125			0.342			1.000 0.000			0.047		
Prop RTs	0.554			0.013			0.551			0.271		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.917			0.998			0.917			0.959		
fLT	0.994			0.983			0.402 1.000			0.934		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3232			3480			782 1783			2912		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	464	3232	# 0.14	0.26	826	0.56
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	827	3480	# 0.24	0.26	889	0.93
Right							
Northbound							
Prot							
Perm							
Left	DefL	234	782	# 0.30	0.32	252	0.93
Prot							
Perm							
Thru	TR	236	1783	0.13	0.32	575	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	473	2912	0.16	0.32	938	0.50
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.56	0.26	29.1	1.000	826	0.50	2.4	0.0	31.6	C	31.6	C	
Westbound													
LTR	0.93	0.26	32.7	1.000	889	0.50	16.4	0.0	49.1	D	49.1	D	
Northbound													
DefL	0.93	0.32	29.5	1.000	252	0.50	40.9	0.0	70.4	E			
TR	0.41	0.32	23.8	1.000	575	0.50	2.2	0.0	26.0	C	48.1	D	
Southbound													
LTR	0.50	0.32	24.7	1.000	938	0.50	1.9	0.0	26.6	C	26.6	C	

Intersection delay = 40.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			234	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			473	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			5.85	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.21	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			4.77	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			24.23	
n=Max(gq-gf)/2,0)			2.38	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.08	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.31	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			4.77	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.40	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.402	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	22
Proportion of LT in LT lane group, PLT	0.125 0.342 0.000 0.047
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	236
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.55
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	11.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.67
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.10
EL1 (refer to Exhibit C16-3)	1.76
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				236
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.047
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.554	0.013	0.551
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	29.1	0.00	0.0	0.0 0.0 0.0	31.6
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	32.7	0.00	0.0	0.0 0.0 0.0	49.1
Northbound								
DefL	0.0	0.00	30.5	29.5	0.00	0.0	0.0	70.4
TR	0.0 0.0	0.00	30.5	23.8	0.00	0.0	0.0 0.0	26.0
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	24.7	0.00	0.0	0.0 0.0 0.0	26.6
Intersection Delay			40.5	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	243		434		234	236	248	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1697		1827		782	1783	1529	
LnCapacity	433		466		252	575	492	
Flow Ratio	0.1		0.2		0.3	0.1	0.2	
v/c Ratio	0.56		0.93		0.93	0.41	0.50	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	5.3		10.6		5.7	4.6	5.0	
kB	0.6		0.6		0.4	0.8	0.7	
Q2	0.7		4.1		2.6	0.5	0.7	
Q Average	6.0		14.7		8.3	5.1	5.7	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	7.4		17.8		10.1	6.4	7.0	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.5	1.5	1.5	
BOQ	8.9		20.9		12.1	7.7	8.5	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.5		1.6	1.7	1.7	
BOQ	9.9		22.5		13.2	8.6	9.5	
QSRatio								
95th Percentile Output:								
fB%	1.9		1.7		1.8	2.0	1.9	
BOQ	11.4		24.4		14.8	10.1	11.0	
QSRatio								
98th Percentile Output:								
fB%	2.2		1.8		2.0	2.2	2.2	
BOQ	12.9		26.2		16.4	11.5	12.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	723	325	4	3	333	427	2	3	2	105	0	275
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	832	1728	0.97	0.73	34.6	C		
TR	1205	1643	0.30	0.73	4.6	A	25.2	C
Westbound								
LT	584	1876	0.61	0.31	29.4	C	38.5	D
R	497	1599	0.90	0.31	45.8	D		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.64	0.16	50.2	D		
LT	283	1818	0.00	0.16	32.1	C	22.4	C
R	862	1492	0.40	0.58	11.8	B		

Intersection Delay = 29.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	723	325	4	3	333	427	2	3	2	105	0	275
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
PK 15 Vol	201	90	1	1	88	112	1	2	1	33	0	86
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	803	365			354	449		17		131	0	344
%InSharedLn										0		
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.011			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.687		0.650			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		33.0	28.0				14.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	723	325	4	3	333	427	2	3	2	105	0	275
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
Adj flow	803	361	4	3	351	449	5	7	5	131	0	344
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	803	365			354	449		17		131	0	344
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.011			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.998		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.297											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1643		1876	1599		952			1310	1818	1492
Sec.	539											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		634	1728	# 0.37	0.367	634	1.00
Perm		169	539	# 0.31	0.367	198	0.85
Left	L	803			0.73	832	0.97
Prot							
Perm							
Thru	TR	365	1643	0.22	0.73	1205	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	354	1876	0.19	0.31	584	0.61
Right	R	449	1599	0.28	0.31	497	0.90
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	131	1310	# 0.10	0.16	204	0.64
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	344	1492	0.23	0.58	862	0.40

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.78$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.88$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.97	0.73	15.8	1.000	832	0.50	18.7	0.0	34.6	C		
TR	0.30	0.73	4.1	1.000	1205	0.50	0.4	0.0	4.6	A	25.2	C
Westbound												
LT	0.61	0.31	26.3	1.000	584	0.50	3.0	0.0	29.4	C	38.5	D
R	0.90	0.31	29.7	1.000	497	0.50	16.1	0.0	45.8	D		
Northbound												
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C
Southbound												
L	0.64	0.16	35.7	1.000	204	0.50	14.5	0.0	50.2	D		
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	22.4	C

R 0.40 0.58 10.4 1.000 862 0.50 1.4 0.0 11.8 B

Intersection delay = 29.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	803			131
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	354			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.08			3.28
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.85			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	15.18			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.82			14.00
n=Max(gq-gf)/2,0)	7.59			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.82			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.38			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	15.18			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.297			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.008	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	365	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.13	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.01	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		365		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.008		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	66.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	66.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.011
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	803			
v/c ratio from Capacity Worksheet, X	0.97			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	15.18			
Unopposed green interval, gu	17.82			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	1.49			
XProt	0.80			
Case	3			
Queue at beginning of green arrow, Qa	7.77			
Queue at beginning of unsaturated green, Qu	3.39			
Residual queue, Qr	2.42			
Uniform Delay, d1	15.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		15.8	0.00	0.0	0.0	34.6
TR	0.0	0.00	12.0	4.1	0.00	0.0	0.0	4.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	26.3	0.00	0.0	0.0	29.4
R	0.0	0.00	31.0	29.7	0.00	0.0	0.0	45.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	35.7	0.00	0.0	0.0	50.2
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.4	0.00	0.0	0.0	11.8
Intersection Delay			29.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	803	365		354	449		17	131	0	344
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1134	1643		1876	1599		952	1310	1818	1492
LnCapacity	832	1205		584	497		148	204	283	862
Flow Ratio	0.7	0.2		0.2	0.3		0.0	0.1	0.0	0.2
v/c Ratio	0.97	0.30		0.61	0.90		0.11	0.64	0.00	0.40
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.3	3.1		7.5	10.8		0.4	3.1	0.0	4.7
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	6.7	0.4		0.8	2.9		0.0	0.6	0.0	0.7
Q Average	15.0	3.5		8.3	13.6		0.4	3.7	0.0	5.4
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.2	1.3	1.2
BOQ	18.1	4.4		10.1	16.5		0.5	4.6	0.0	6.7
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.5	1.4		1.7	1.5	1.7	1.5
BOQ	21.2	5.4		12.1	19.4		0.7	5.7	0.0	8.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6	1.5		2.0	1.7	2.0	1.7
BOQ	22.9	6.1		13.2	20.9		0.8	6.4	0.0	9.0
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8	1.7		2.5	2.1	2.6	1.9
BOQ	24.7	7.4		14.8	22.7		1.0	7.7	0.0	10.5
QSRatio										
98th Percentile Output:										
fB%	1.8	2.4		2.0	1.8		3.1	2.4	3.2	2.2
BOQ	26.6	8.6		16.4	24.5		1.2	8.9	0.0	11.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2015 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	398	35	0	1	35	42	3	3	2	60	1	725
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	755	1509	0.59	0.50	19.1	B		
TR	1066	2132	0.04	0.50	11.5	B	18.4	B

LTR	1561	3122	0.05	0.50	11.6	B	11.6	B
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LTR	1220	3137	0.01	0.39	16.9	B	16.9	B
-----	------	------	------	------	------	---	------	---

LT	550	1414	0.12	0.39	18.0	B	29.5	C
R	616	1583	0.75	0.39	31.2	C		

Intersection Delay = 23.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	398	35	0	1	35	42	3	3	2	60	1	725
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	111	10	0	1	9	11	2	2	1	16	1	193
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	442	39			72			16			65	459
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	398	35	0	1	35	42	3	3	2	60	1	725
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	442	39	0	1	37	34	6	6	4	64	1	459
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	442	39			72			16			65	459
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.708	1.000			0.954			0.910		0.759	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1509	2132			3122			3137		1414	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	442	1509	# 0.29	0.50	755	0.59
Prot							
Perm							
Thru	TR	39	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	72	3122	0.02	0.50	1561	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3137	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	65	1414	0.05	0.39	550	0.12
Right	R	459	1583	# 0.29	0.39	616	0.75

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.59	0.50	15.9	1.000	755	0.50	3.2	0.0	19.1	B			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	18.4	B	
Westbound													
LTR	0.05	0.50	11.5	1.000	1561	0.50	0.1	0.0	11.6	B	11.6	B	
Northbound													
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.12	0.39	17.6	1.000	550	0.50	0.4	0.0	18.0	B	29.5	C	

R 0.75 0.39 23.7 1.000 616 0.50 7.5 0.0 31.2 C

Intersection delay = 23.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	442			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	72			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	11.05			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.95			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.41			
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.708			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	64	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.985
Proportion of LT in opposing flow, PLTo	0.00	0.98	0.38	
Adjusted opposing flow rate, Vo (veh/h)	39	65	16	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.60	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.49	1.63	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	5.2	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	29.83	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.02	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.98	
EL1 (refer to Exhibit C16-3)	1.43	1.47	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.759	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	72	39	65	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.472	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.9	0.00	0.0	0.0	19.1
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.0
R	0.0	0.00	27.5	23.7	0.00	0.0	0.0	31.2
Intersection Delay			23.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	442	39			37				8				65	459	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1509	2132			1639				1647				1414	1583	
LnCapacity	755	1066			819				640				550	616	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.3	
v/c Ratio	0.59	0.04			0.05				0.01				0.12	0.75	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	7.8	0.5			0.5				0.1				1.0	9.9	
kB	0.9	1.1			1.0				0.8				0.7	0.8	
Q2	1.2	0.0			0.0				0.0				0.1	2.0	
Q Average	9.0	0.5			0.5				0.1				1.1	11.9	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	11.0	0.7			0.7				0.2				1.5	14.4	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	13.1	0.9			0.9				0.2				1.9	17.0	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			2.0				2.0				1.9	1.5	
BOQ	14.3	1.1			1.0				0.3				2.2	18.4	
QSRatio															
95th Percentile Output:															
fB%	1.8	2.5			2.5				2.6				2.4	1.7	
BOQ	15.9	1.3			1.3				0.3				2.7	20.1	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.1				3.2				2.9	1.8	
BOQ	17.6	1.6			1.6				0.4				3.3	21.9	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	142		23				2	269			655	302
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.30	0.32	16.8	B	16.6	B
R	473	1495	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1729 3347 0.18 0.52 7.9 A 7.9 A

Southbound

TR 1978 3829 0.53 0.52 10.5 B 10.5 B

Intersection Delay = 10.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	142		23				2	269		655	302	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	41		7				1	76		180	83	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	163		20					308			1052	
%InSharedLn												
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.316	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	142		23				2	269		655	302	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	163		20				2	306		720	332	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	163		20					308			1052	
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.316	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.926	0.926			0.990		0.980	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.953	
fLT	0.950				0.950		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1727	1495			3347		3829	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	163	1727	# 0.09	0.32	547	0.30
Prot							
Perm							
Thru							
Right	R	20	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	308	3347	0.09	0.52	1729	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1052	3829	# 0.27	0.52	1978	0.53
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.30	0.32	15.5	1.000	547	0.50	1.4	0.0	16.8	B	16.6	B	
R	0.04	0.32	14.2	1.000	473	0.50	0.2	0.0	14.4	B			
Westbound													
Northbound													
LT	0.18	0.52	7.7	1.000	1729	0.50	0.2	0.0	7.9	A	7.9	A	
Southbound													
TR	0.53	0.52	9.7	1.000	1978	0.50	0.8	0.0	10.5	B	10.5	B	

Intersection delay = 10.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.006 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1052
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.21
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	7.84
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	4.12
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.950

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			7.84	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.253	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1052	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.006	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)				31.0
Conflicting pedestrian volume, Vped (p/h)				0
Conflicting bicycle volume, Vbic (bicycles/h)				0
Vpedg				0
OCCpedg				0.000
Effective green, g (s)				31.0
Vbicg				0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.316
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.5	0.00	0.0	0.0	16.8
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	7.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.7	0.00	0.0	0.0	10.5
	0.0						0.0	
Intersection Delay			10.7	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	163	20				161		552	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1727	1495				1757		2011	
LnCapacity	547	473				908		1038	
Flow Ratio	0.1	0.0				0.1		0.3	
v/c Ratio	0.30	0.04				0.18		0.53	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	2.0	0.2				1.4		6.1	
kB	0.5	0.5				0.8		0.7	
Q2	0.2	0.0				0.2		0.8	
Q Average	2.3	0.3				1.6		6.9	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.9	0.3				2.0		8.5	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.5	
BOQ	3.6	0.4				2.6		10.2	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	4.1	0.5				3.0		11.2	
QSRatio									
95th Percentile Output:									
fB%	2.2	2.6				2.3		1.9	
BOQ	5.1	0.6				3.7		12.8	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.1				2.8		2.1	
BOQ	6.0	0.8				4.5		14.4	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		445	2		4			22	512	4
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.42	0.42	14.4	B		
LT	576	1383	0.44	0.42	14.9	B	14.6	B

Northbound

L	276	662	0.02	0.42	10.4	B	10.4	B
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Southbound

LTR	2057	4938	0.29	0.42	11.9	B	11.9	B
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Intersection Delay = 13.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		445	2		4			22	512	4
% Heavy Veh	1	1		3	3		1			1	1	1
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol	1	0		125	1		1			6	141	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			250	252		5			591		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.992		1.000				0.041	
Prop RTs	0.000			0.000						0.007		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.988		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		445	2		4			22	512	4
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	4	0		500	2		5			24	563	4
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	4			250	252		5			591		
Prop LTs	0.000			1.000 0.992			1.000			0.041		
Prop RTs	0.000			0.000						0.007		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.999	
fLT	1.000		0.755 0.726		0.377		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1439 1383		662		4938	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	250	1439	0.17	0.42	600	0.42
Prot							
Perm							
Thru	LT	252	1383	# 0.18	0.42	576	0.44
Right							
Northbound							
Prot							
Perm							
Left	L	5	662	0.01	0.42	276	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	591	4938	# 0.12	0.42	2057	0.29
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.30
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.36

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.42	0.42	12.4	1.000	600	0.50	2.1	0.0	14.4	B		
LT	0.44	0.42	12.5	1.000	576	0.50	2.4	0.0	14.9	B	14.6	B
Northbound												
L	0.02	0.42	10.3	1.000	276	0.50	0.1	0.0	10.4	B	10.4	B
Southbound												
LTR	0.29	0.42	11.6	1.000	2057	0.50	0.4	0.0	11.9	B	11.9	B

Intersection delay = 13.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		250	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		4	591	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.17	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.62	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	2.43	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	22.57	
n=Max(gq-gf)/2,0)		0.00	1.22	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.39	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.21	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	2.43	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.38	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.377	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	250		
Proportion of LT in LT lane group, PLT	0.000	0.992	0.041
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.17		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	4		250	252	5			216	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	0	3
SL	1881		1439	1383	662			1812	
LnCapacity	784		600	576	276			755	
Flow Ratio	0.0		0.2	0.2	0.0			0.1	
v/c Ratio	0.01		0.42	0.44	0.02			0.29	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.988			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		2.9	3.0	0.0			2.4	
kB	0.7		0.6	0.6	0.3			0.7	
Q2	0.0		0.4	0.4	0.0			0.3	
Q Average	0.0		3.4	3.4	0.1			2.7	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.3	1.3	1.3			1.3	
BOQ	0.1		4.2	4.3	0.1			3.4	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.6	1.6	1.7			1.6	
BOQ	0.1		5.2	5.3	0.1			4.2	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.8	1.8	2.0			1.8	
BOQ	0.1		5.9	6.0	0.1			4.8	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.1	2.1	2.6			2.2	
BOQ	0.1		7.1	7.2	0.1			5.8	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.5	2.5	3.2			2.6	
BOQ	0.1		8.3	8.4	0.2			6.9	
QSRatio									

ERROR MESSAGES

No errors to report.

Vehicle Volumes and Adjustments

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			407			
Peak Hour Factor, PHF			0.88			
Hourly Flow Rate, HFR			462			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach:	Exists?/Storage			/		/
Lanes			1			
Configuration			R			

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					462			
C(m) (vph)					1045			
v/c					0.44			
95% queue length					2.30			
Control Delay					11.1			
LOS					B			
Approach Delay				11.1				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
------------------------	--------	--------	--------	--------	--------	--------

Volume 23
 Peak-Hour Factor, PHF 0.71
 Peak-15 Minute Volume 8
 Hourly Flow Rate, HFR 32
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No No

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume 407
 Peak Hour Factor, PHF 0.88
 Peak-15 Minute Volume 116
 Hourly Flow Rate, HFR 462
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					32			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	32	
Potential Capacity	1045	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1045	
Probability of Queue free St.	0.56	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.56
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.56
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	---------	---------	---------

Volume (vph)			462			
Movement Capacity (vph)			1045			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1045			
Volume			462			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					462			
C(m) (vph)					1045			
v/c					0.44			
95% queue length					2.30			
Control Delay					11.1			
LOS					B			
Approach Delay				11.1				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	103	37	137	81	0	0	0	0	23	86	24
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	174		278				72 73	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	174		278				72	73
Left-Turn	0		175				25	0
Right-Turn	46		0				0	26
Prop. Left-Turns	0.0		0.6				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.4
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	37	88	0	0	154	19	63	97	138	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	155		221		111		188	
% Heavy Veh	2		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	155		221		111	188		
Left-Turn	46		0		63	0		
Right-Turn	0		24		0	139		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	187	132	111	7	46	8	402	102	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	530	1515	0.71	0.35	24.6	C	22.9	C
R	560	1599	0.12	0.35	13.7	B		

Westbound

LTR	532	1519	0.13	0.35	13.8	B	13.8	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2302	4762	0.25	0.48	9.3	A	9.3	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 15.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	187	132	111	7	46	8	402	102	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	55	39	33	2	13	2	113	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		375	68		70			569				
%InSharedLn												
Prop LTs		0.587			0.114			0.794				
Prop RTs		0.000	1.000		0.129			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	187	132	111	7	46	8	402	102	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	220	155	68	8	53	9	452	115	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		375	68		70			569				
Prop LTs		0.587			0.114			0.794				
Prop RTs		0.000	1.000		0.129			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.990	0.990	0.990		0.990			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.983		0.999			
fLT	0.780		0.955		0.962			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1515	1599	1519		4762			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.71	0.35	16.8	1.000	530	0.50	7.8	0.0	24.6	C	22.9	C
R	0.12	0.35	13.2	1.000	560	0.50	0.4	0.0	13.7	B		
Westbound												
LTR	0.13	0.35	13.3	1.000	532	0.50	0.5	0.0	13.8	B	13.8	B
Northbound												
LTR	0.25	0.48	9.1	1.000	2302	0.50	0.3	0.0	9.3	A	9.3	A
Southbound												

Intersection delay = 15.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	220	8	
Proportion of LT in LT lane group, PLT	0.587	0.114	0.794
Proportion of LT in opposing flow, PLTo	0.11	0.59	
Adjusted opposing flow rate, Vo (veh/h)	70	375	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.67	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.17	6.25	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	7.65	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.89	0.41	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.59	0.11	
EL1 (refer to Exhibit C16-3)	1.48	2.03	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.78	0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.780	0.955	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	7.65		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.364		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	70	375	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.587	0.114	0.794	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.129	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	16.8	0.00	0.0	0.0	24.6
R	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.3	0.00	0.0	0.0	13.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.1	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			15.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	375	68	70	208			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1 0	0 3 0	0 0	0	
SL	1515	1599	1519	1748			
LnCapacity	530	560	532	845			
Flow Ratio	0.2	0.0	0.0	0.1			
v/c Ratio	0.71	0.12	0.13	0.25			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	5.4	0.8	0.8	2.0			
kB	0.6	0.6	0.6	0.7			
Q2	1.3	0.1	0.1	0.2			
Q Average	6.7	0.8	0.9	2.3			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	8.2	1.1	1.1	2.9			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.7	1.7	1.6			
BOQ	9.8	1.4	1.5	3.6			
QSRatio							
90th Percentile Output:							
fB%	1.6	1.9	1.9	1.8			
BOQ	10.9	1.6	1.7	4.1			
QSRatio							
95th Percentile Output:							
fB%	1.9	2.4	2.4	2.2			
BOQ	12.4	2.1	2.1	5.1			
QSRatio							
98th Percentile Output:							
fB%	2.1	3.0	3.0	2.7			
BOQ	13.9	2.5	2.6	6.0			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	101		33				18	451		451	44	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	455	1705	0.31	0.27	19.3	B	19.3	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1099	1939	0.50	0.57	9.2	A	9.2	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1127	1988	0.48	0.57	9.0	A	9.0	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 10.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	101		33				18	451		451	44	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	26		9				5	131		123	12	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		139						545			538	
%InSharedLn												
Prop LTs		0.755						0.039			0.000	
Prop RTs		0.245						0.000			0.089	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	101		33				18	451		451	44	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	105		34				21	524		490	48	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		139						545			538	
Prop LTs		0.755						0.039			0.000	
Prop RTs		0.245						0.000			0.089	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.967						1.000			0.988		
fLT	0.964						0.974			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1705						1939			1988		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	139	1705	# 0.08	0.27	455	0.31
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	545	1939	# 0.28	0.57	1099	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	538	1988	0.27	0.57	1127	0.48
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.36

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.31	0.27	17.6	1.000	455	0.50	1.7	0.0	19.3	B	19.3	B
Westbound												
Northbound												
LT	0.50	0.57	7.8	1.000	1099	0.50	1.4	0.0	9.2	A	9.2	A
Southbound												
TR	0.48	0.57	7.7	1.000	1127	0.50	1.3	0.0	9.0	A	9.0	A

Intersection delay = 10.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		21	
Proportion of LT in LT lane group, PLT	0.755	0.039	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		538	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.35	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.97	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		16.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		5.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.39	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.974	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.83	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.171	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			538	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.039	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.089
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	17.6	0.00	0.0	0.0 0.0 0.0	19.3
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	7.8	0.00	0.0	0.0 0.0 0.0	9.2
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	7.7	0.00	0.0	0.0 0.0 0.0	9.0
Intersection Delay			10.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	139						545			538		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1705						1939			1988		
LnCapacity	455						1099			1127		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.31						0.50			0.48		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.8						5.5			5.3		
kB	0.5						0.8			0.8		
Q2	0.2						0.8			0.8		
Q Average	2.1						6.3			6.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.6						7.7			7.5		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.3						9.3			9.1		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.8						10.3			10.0		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	4.7						11.8			11.5		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.1		
BOQ	5.6						13.3			13.0		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	143		83				22	444		388		154
Lane Width		16.0						16.0		16.0		
RTOR Vol			0									21

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 573 1719 0.49 0.33 18.7 B 18.7 B

Westbound

Northbound

LT 891 1782 0.61 0.50 13.4 B 13.4 B

Southbound

TR 981 1962 0.58 0.50 12.7 B 12.7 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	143		83				22	444		388	154	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	45		26				6	129		105	42	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		283						542			567	
%InSharedLn												
Prop LTs		0.633						0.048			0.000	
Prop RTs		0.367						0.000			0.256	
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	143		83				22	444		388	154	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	179		104				26	516		422	145	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		283						542			567	
Prop LTs		0.633						0.048			0.000	
Prop RTs		0.367						0.000			0.256	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.950						1.000			0.965		
fLT	0.969						0.963			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1719						1782			1962		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	283	1719	# 0.16	0.33	573	0.49
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	542	1782	# 0.30	0.50	891	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	567	1962	0.29	0.50	981	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.47
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.49	0.33	16.0	1.000	573	0.50	2.8	0.0	18.7	B	18.7	B
Westbound												
Northbound												
LT	0.61	0.50	10.8	1.000	891	0.50	2.6	0.0	13.4	B	13.4	B
Southbound												
TR	0.58	0.50	10.5	1.000	981	0.50	2.2	0.0	12.7	B	12.7	B

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

1.000 1.000 1.000

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s) 30.0

Effective permitted green time for LT lane group, g(s) 30.0

Opposing effective green time, go (s) 30.0

Number of lanes in LT lane group, N 1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		26	
Proportion of LT in LT lane group, PLT	0.633	0.048	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		567	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.43	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.45	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		13.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		8.12	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.95	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.46	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.963	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			8.12	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.271	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		567	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.633		0.048	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.367	0.256
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	16.0	0.00	0.0	0.0 0.0 0.0	18.7
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	10.8	0.00	0.0	0.0 0.0 0.0	13.4
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	10.5	0.00	0.0	0.0 0.0 0.0	12.7
Intersection Delay			14.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	283						542			567		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1719						1782			1962		
LnCapacity	573						891			981		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.49						0.61			0.58		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.8						6.5			6.6		
kB	0.5						0.7			0.7		
Q2	0.5						1.0			1.0		
Q Average	4.3						7.5			7.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.3						9.2			9.3		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	6.5						11.0			11.2		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.3						12.1			12.3		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.8		
BOQ	8.7						13.7			13.9		
QSRatio												
98th Percentile Output:												
fB%	2.3						2.0			2.0		
BOQ	10.0						15.3			15.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		114	266	450	266	51	198		479	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	32.0	C
R	220	1652	0.55	0.13	32.3	C		
Westbound								
LTR	1329	4689	0.84	0.28	23.6	C	23.6	C
Northbound								
L	124	373	0.44	0.33	26.0	C		
T	616	1848	0.35	0.33	16.5	B	18.5	B
Southbound								
TR	670	2010	0.83	0.33	28.6	C	28.6	C

Intersection Delay = 24.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		114	266	450	266	51	198		479	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		30	76	128	76	14	54		138	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		120		1115		55	215			557	
%InSharedLn												
Prop LTs					0.271		1.000	0.000			0.000	
Prop RTs			1.000		0.271			0.000			0.011	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		114	266	450	266	51	198		479	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		120	302	511	302	55	215		551	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		120		1115		55	215		557		
Prop LTs					0.271		1.000	0.000		0.000		
Prop RTs			1.000		0.271			0.000		0.011		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.990		0.980	0.980	0.962	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.972	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.959			1.000	0.999	
fLT	0.950		0.987		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4689		373	1848	2010	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	120	1652	# 0.07	0.13	220	0.55
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1115	4689	# 0.24	0.28	1329	0.84
Right							
Northbound							
Prot							
Perm							
Left	L	55	373	0.15	0.33	124	0.44
Prot							
Perm							
Thru	T	215	1848	0.12	0.33	616	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	557	2010	# 0.28	0.33	670	0.83
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.59

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	32.0	C	
R	0.55	0.13	24.3	1.000	220	0.50	8.0	0.0	32.3	C			
Westbound													
LTR	0.84	0.28	20.2	1.000	1329	0.50	3.4	0.0	23.6	C	23.6	C	
Northbound													
L	0.44	0.33	15.6	1.000	124	0.50	10.3	0.0	26.0	C	18.5	B	
T	0.35	0.33	15.1	1.000	616	0.50	1.4	0.0	16.5	B			
Southbound													
TR	0.83	0.33	18.4	1.000	670	0.50	10.1	0.0	28.6	C	28.6	C	

Intersection delay = 24.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			55	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			557	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			0.92	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.28	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			12.56	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			7.44	
n=Max(gq-gf)/2,0)			6.28	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.20	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.271 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 PTHo=1-PLTo
 $PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N-1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			12.56	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.628	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			557	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.271	0.011
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	24.3	0.00	0.0	0.0	32.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.2	0.00	0.0	0.0	23.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.6	0.00	0.0	0.0	26.0
T	0.0	0.00	20.0	15.1	0.00	0.0	0.0	16.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.4	0.00	0.0	0.0	28.6
	0.0						0.0	
Intersection Delay			24.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	120		409		55	215		557
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1721		373	1848		2010
LnCapacity	222	220		487		124	616		670
Flow Ratio	0.0	0.1		0.2		0.1	0.1		0.3
v/c Ratio	0.02	0.55		0.84		0.44	0.35		0.83
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.9		6.4		0.7	2.7		8.6
kB	0.3	0.3		0.3		0.2	0.6		0.6
Q2	0.0	0.3		1.2		0.1	0.3		2.4
Q Average	0.1	2.2		7.6		0.9	3.0		10.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	2.7		9.3		1.1	3.8		13.2
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.7	1.6		1.4
BOQ	0.1	3.5		11.2		1.4	4.7		15.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.1	4.0		12.3		1.7	5.3		17.0
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		1.8		2.4	2.1		1.7
BOQ	0.2	4.9		13.9		2.1	6.5		18.7
QSRatio									
98th Percentile Output:									
fB%	3.2	2.7		2.0		3.0	2.5		1.9
BOQ	0.2	5.8		15.4		2.6	7.6		20.4
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	9	20	6				8	240	118	308	502	50
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 460 1623 0.12 0.28 16.5 B 16.5 B

Westbound

Northbound

LTR 953 1733 0.42 0.55 9.1 A 9.1 A

Southbound

L 538 979 0.62 0.55 12.1 B
 TR 985 1791 0.59 0.55 10.5 B 11.1 B

Intersection Delay = 10.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	20	6				8	240	118	308	502	50
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				2	65	32	83	135	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		56						398		331	581	
%InSharedLn												
Prop LTs		0.250						0.023		1.000	0.000	
Prop RTs		0.179						0.322			0.071	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	20	6				8	240	118	308	502	50
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
Adj flow	14	32	10				9	261	128	331	540	41
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	56						398			331	581	
Prop LTs	0.250						0.023			1.000	0.000	
Prop RTs	0.179						0.322			0.071		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.980	0.980	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.992			1.000	0.972	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.976							0.957				0.989	
fLT	0.988							0.988			0.525	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1623							1733			979	1791	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	56	1623	# 0.03	0.28	460	0.12
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	398	1733	0.23	0.55	953	0.42
Right							
Southbound							
Prot							
Perm							
Left	L	331	979	# 0.34	0.55	538	0.62
Prot							
Perm							
Thru	TR	581	1791	0.32	0.55	985	0.59
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.37$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.45$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.12	0.28	16.0	1.000	460	0.50	0.5	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.42	0.55	7.9	1.000	953	0.50	1.2	0.0	9.1	A	9.1	A
Southbound												
L	0.62	0.55	9.2	1.000	538	0.50	3.0	0.0	12.1	B		
TR	0.59	0.55	9.0	1.000	985	0.50	1.5	0.0	10.5	B	11.1	B

Intersection delay = 10.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				331
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				398
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.52
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.63
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.96
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.04
n=Max(gq-gf)/2,0)				1.98
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.90
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.96
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.96
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.53
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.525

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		9	
Proportion of LT in LT lane group, PLT	0.250	0.023	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		581	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.15	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.68	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		6.95	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		11.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.49	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.988	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.95	3.96
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.211	0.120
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			581	398
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.023	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.179	0.322	0.071
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.0	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.9	0.00	0.0	0.0	9.1
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.2	0.00	0.0	0.0	12.1
TR	0.0	0.00	13.5	9.0	0.00	0.0	0.0	10.5
	0.0						0.0	

Intersection Delay	10.7	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		56						398			331	581
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1623						1733			979	1791
LnCapacity		460						953			538	985
Flow Ratio		0.0						0.2			0.3	0.3
v/c Ratio		0.12						0.42			0.62	0.59
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.922				0.564
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.7						3.9			3.8	6.4
kB		0.5						0.8			0.3	0.5
Q2		0.1						0.5			0.5	0.7
Q Average		0.8						4.4			4.2	7.1
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.0						5.5			5.3	8.7
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.5	1.5
BOQ		1.3						6.7			6.5	10.5
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.5						7.5			7.3	11.6
QSRatio												
95th Percentile Output:												
fB%		2.5						2.0			2.0	1.8
BOQ		1.9						8.9			8.6	13.1
QSRatio												
98th Percentile Output:												
fB%		3.0						2.3			2.3	2.1
BOQ		2.3						10.3			9.9	14.7
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	6	12	20	258	28	106	18	254	169	91	382	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	632	1421	0.09	0.44	14.7	B	14.7	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	560	1261	0.53	0.44	21.4	C		
T	792	1783	0.04	0.44	14.2	B	19.4	B
R	585	1316	0.21	0.44	16.0	B		

Northbound

LTR	727	1635	0.66	0.44	22.8	C	22.8	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	640	1439	0.87	0.44	26.5	C	26.5	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 22.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	12	20	258	28	106	18	254	169	91	382	9
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	4	7	74	8	30	5	69	46	26	110	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		55		297	32	122		480			554	
%InSharedLn												
Prop LTs		0.164		1.000	0.000			0.042			0.190	
Prop RTs		0.527			0.000	1.000		0.383			0.018	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	12	20	258	28	106	18	254	169	91	382	9
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	17	29	297	32	122	20	276	184	105	439	10
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	55			297	32	122	480			554		
Prop LTs	0.164			1.000	0.000		0.042			0.190		
Prop RTs	0.527			0.000 1.000			0.383			0.018		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.929		1.000 0.850			0.948		0.998		
fLT	0.975		0.721	1.000		0.969		0.778		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.995		
fRpb	0.970		1.000 1.000			0.979		1.000		
S	1421		1261	1783	1316	1635		1439		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	55	1421	0.04	0.44	632	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	297	1261	# 0.24	0.44	560	0.53
Prot							
Perm							
Thru	T	32	1783	0.02	0.44	792	0.04
Right	R	122	1316	0.09	0.44	585	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	480	1635	0.29	0.44	727	0.66
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	554	1439	# 0.38	0.44	640	0.87
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.4	1.000	632	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.53	0.44	18.2	1.000	560	0.50	3.2	0.0	21.4	C	19.4	B
T	0.04	0.44	14.1	1.000	792	0.50	0.1	0.0	14.2	B		
R	0.21	0.44	15.3	1.000	585	0.50	0.7	0.0	16.0	B		
Northbound												
LTR	0.66	0.44	19.7	1.000	727	0.50	3.1	0.0	22.8	C	22.8	C
Southbound												
LTR	0.87	0.44	22.6	1.000	640	0.50	3.9	0.0	26.5	C	26.5	C

Intersection delay = 22.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		297		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		55		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.43		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.38		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.721		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	105
Proportion of LT in LT lane group, PLT	0.164	0.000	0.042
Proportion of LT in opposing flow, PLTo	0.00	0.19	0.04
Adjusted opposing flow rate, Vo (veh/h)	32	554	480
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.63
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.80	13.85	12.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	17.9	3.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.63	12.60
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	22.06	27.40
n=Max(gq-gf)/2,0)	0.00	0.00	4.67
PTHo=1-PLTo	1.00	0.81	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.19
EL1 (refer to Exhibit C16-3)	1.42	2.43	2.25
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.33
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	9.34
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.97	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.975	0.969	0.778

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.63	12.60
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.366	0.315
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	32	55	554	480
OCCr	0.000	0.052	0.000	0.024
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.976
Proportion of left turns, PLT	0.164	1.000	0.042	0.190
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.995
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.527	1.000	0.383	0.018
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.970	1.000	0.979	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.4	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.2	0.00	0.0	0.0	21.4
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	19.7	0.00	0.0	0.0	22.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	22.6	0.00	0.0	0.0	26.5
	0.0						0.0	
Intersection Delay			22.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		55	297	32	122		480		554
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	1
SL		1421	1261	1783	1316		1635		1439
LnCapacity		632	560	792	585		727		640
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.09	0.53	0.04	0.21		0.66		0.87
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.905			0.663		0.229
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	5.4	0.5	1.9		9.4		12.5
kB		0.8	0.7	0.9	0.7		0.6		0.2
Q2		0.1	0.8	0.0	0.2		1.1		1.1
Q Average		0.9	6.2	0.5	2.1		10.6		13.6
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.1	7.6	0.6	2.6		12.8		16.4
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.4	9.2	0.8	3.3		15.2		19.3
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.6		1.5
BOQ		1.7	10.1	1.0	3.8		16.5		20.9
QSRatio									
95th Percentile Output:									
fB%		2.4	1.9	2.5	2.3		1.7		1.7
BOQ		2.1	11.6	1.2	4.6		18.2		22.7
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.9		1.8
BOQ		2.6	13.2	1.5	5.5		19.9		24.5
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	143		245	68	157		139		72			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	928	1856	0.43	0.50	15.7	B	15.7	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	753	1505	0.36	0.50	15.0	B	15.0	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	572	1470	0.55	0.39	24.8	C	24.8	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 18.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		143	245	68	157		139		72			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		44	75	20	47		52		27			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59						0			
Adj Flow		401			271			314				
%InSharedLn												
Prop LTs		0.000			0.303			0.659				
Prop RTs		0.566			0.000			0.341				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		143	245	68	157		139		72			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		174	227	82	189		207		107			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		401			271			314				
Prop LTs		0.000			0.303			0.659				
Prop RTs		0.566			0.000			0.341				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.924			1.000			0.954					
fLT	1.000			0.755			0.968					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1856			1505			1470					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	401	1856	# 0.22	0.50	928	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	271	1505	0.18	0.50	753	0.36
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	314	1470	# 0.21	0.39	572	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.43	0.50	14.4	1.000	928	0.50	1.4	0.0	15.7	B	15.7	B
Westbound												
LT	0.36	0.50	13.7	1.000	753	0.50	1.3	0.0	15.0	B	15.0	B
Northbound												
LR	0.55	0.39	21.4	1.000	572	0.50	3.5	0.0	24.8	C	24.8	C
Southbound												

Intersection delay = 18.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	82		
Proportion of LT in LT lane group, PLT	0.000	0.303	0.659
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	401		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	2.05		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	6.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	8.72		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	36.28		
n=Max(gq-gf)/2,0)	1.03		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.30		
EL1 (refer to Exhibit C16-3)	2.08		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.76		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.755		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.4	0.00	0.0	0.0	15.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	13.7	0.00	0.0	0.0	15.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	21.4	0.00	0.0	0.0	24.8
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			18.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		401			271			314				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1856			1505			1470				
LnCapacity		928			753			572				
Flow Ratio		0.2			0.2			0.2				
v/c Ratio		0.43			0.36			0.55				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.989			0.917				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		6.4			4.1			6.1				
kB		1.0			0.9			0.7				
Q2		0.8			0.5			0.8				
Q Average		7.1			4.6			6.9				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		8.8			5.8			8.5				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		10.5			7.1			10.2				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.7			1.6				
BOQ		11.6			7.9			11.3				
QSRatio												
95th Percentile Output:												
fB%		1.8			2.0			1.8				
BOQ		13.2			9.3			12.8				
QSRatio												
98th Percentile Output:												
fB%		2.1			2.3			2.1				
BOQ		14.7			10.7			14.4				
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	26	32	23	60	17	40	11	208	49	28	233	27
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 238 2039 0.85 0.12 55.6 E 55.6 E

Westbound

LTR 501 2003 0.30 0.25 19.8 B 19.8 B

Northbound

LTR 761 1986 0.38 0.38 14.8 B 14.8 B

Southbound

LTR 731 1906 0.45 0.38 15.8 B 15.8 B

Intersection Delay = 24.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	26	32	23	60	17	40	11	208	49	28	233	27
% Heavy Veh	0	0	0	0	0	0	3	3	3	5	5	5
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
PK 15 Vol	16	20	14	19	5	13	3	57	13	8	66	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		202			150			291			328	
%InSharedLn												
Prop LTs		0.322			0.513			0.041			0.098	
Prop RTs		0.282			0.340			0.182			0.095	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	26	32	23	60	17	40	11	208	49	28	233	27
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
Adj flow	65	80	57	77	22	51	12	226	53	32	265	31
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	202			150			291			328		
Prop LTs	0.322			0.513			0.041			0.098		
Prop RTs	0.282			0.340			0.182			0.095		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	1.000			1.000			0.971			0.952		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.962			0.954			0.975			0.987		
fLT	0.984			0.975			0.982			0.949		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2039			2003			1986			1906		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	202	2039	# 0.10	0.12	238	0.85
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	150	2003	# 0.07	0.25	501	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	291	1986	0.15	0.38	761	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	328	1906	# 0.17	0.38	731	0.45
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.85	0.12	26.0	1.000	238	0.50	29.6	0.0	55.6	E	55.6	E	
Westbound													
LTR	0.30	0.25	18.2	1.000	501	0.50	1.5	0.0	19.8	B	19.8	B	
Northbound													
LTR	0.38	0.38	13.4	1.000	761	0.50	1.5	0.0	14.8	B	14.8	B	
Southbound													
LTR	0.45	0.38	13.8	1.000	731	0.50	2.0	0.0	15.8	B	15.8	B	

Intersection delay = 24.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			12	32
Proportion of LT in LT lane group, PLT	0.322	0.513	0.041	0.098
Proportion of LT in opposing flow, PLTo			0.10	0.04
Adjusted opposing flow rate, Vo (veh/h)			328	291
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.20	0.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.47	4.85
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			11.8	7.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			5.80	4.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.17	15.11
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.90	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.04	0.10
EL1 (refer to Exhibit C16-3)			1.94	1.86
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.982	0.949

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				4.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.211
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				291
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.098
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.282	0.182
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	26.0	0.00	0.0	0.0	55.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.2	0.00	0.0	0.0	19.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.4	0.00	0.0	0.0	14.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.8	0.00	0.0	0.0	15.8
	0.0						0.0	
Intersection Delay			24.4	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	202		150		291		328	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	1 0	0 0	1 0	0 0	1 0	0 0
SL	2039		2003		1986		1906	
LnCapacity	238		501		761		731	
Flow Ratio	0.1		0.1		0.1		0.2	
v/c Ratio	0.85		0.30		0.38		0.45	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	3.3		2.0		3.5		4.1	
kB	0.3		0.5		0.7		0.7	
Q2	1.4		0.2		0.4		0.6	
Q Average	4.7		2.3		3.9		4.6	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.2		1.2	
BOQ	5.8		2.8		4.9		5.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.5		1.5	
BOQ	7.1		3.6		6.1		7.0	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.7		1.7	
BOQ	7.9		4.1		6.8		7.9	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.2		2.1		2.0	
BOQ	9.3		5.0		8.1		9.2	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.7		2.4		2.3	
BOQ	10.7		6.0		9.4		10.6	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			250	12		16	300	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			271	13		18	340	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		9		19				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		12		25				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			18			37					
C(m) (vph)			1261			604					
v/c			0.01			0.06					
95% queue length			0.04			0.20					
Control Delay			7.9			11.3					
LOS			A			B					
Approach Delay						11.3					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		250	12	16	300	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		68	3	5	85	
Hourly Flow Rate, HFR		271	13	18	340	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	9		19			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	12		25			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		340
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		284	654		278			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	278	
Potential Capacity	758	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	758	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	284	
Potential Capacity	1261	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1261	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	654	
Potential Capacity	430	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.95
Movement Capacity	424	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 654
Potential Capacity 430
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.95
Movement Capacity 424

Results for Two-stage process:

a
y
C t 424

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	12		25			
Movement Capacity (vph)	424		758			
Shared Lane Capacity (vph)		604				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	424		758			
Volume	12		25			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		604				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		18		37				
C(m) (vph)		1261		604				
v/c		0.01		0.06				
95% queue length		0.04		0.20				
Control Delay		7.9		11.3				
LOS		A		B				
Approach Delay				11.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		340
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		7.9
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.1

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	9	5	351	26	353	5	162	352	155	204	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	724	1738	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	547	1314	0.75	0.42	22.7	C	22.0	C
R	539	1293	0.71	0.42	21.2	C		

Northbound

LTR	745	1787	0.77	0.42	21.4	C	21.4	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	437	1049	0.90	0.42	40.7	D	40.7	D
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 25.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	9	5	351	26	353	5	162	352	155	204	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	95	7	96	2	45	97	43	56	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		15			410	384		570			394	
%InSharedLn												
Prop LTs		0.000			0.932			0.009			0.431	
Prop RTs		0.333			0.000	1.000		0.679			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	9	5	351	26	353	5	162	352	155	204	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	10	5	382	28	384	5	178	387	170	224	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	15			410 384			570			394		
Prop LTs	0.000			0.932			0.009			0.431		
Prop RTs	0.333			0.000 1.000			0.679			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.955			1.000 0.850			0.908			1.000		
fLT	1.000			0.730			0.997			0.506		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1738			1314 1293			1787			1049		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	15	1738	0.01	0.42	724	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	410	1314	# 0.31	0.42	547	0.75
Right	R	384	1293	0.30	0.42	539	0.71
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	570	1787	0.32	0.42	745	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	394	1049	# 0.38	0.42	437	0.90
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	724	0.50	0.1	0.0	10.3	B	10.3	B
Westbound												
LT	0.75	0.42	14.8	1.000	547	0.50	7.8	0.0	22.7	C	22.0	C
R	0.71	0.42	14.5	1.000	539	0.50	6.7	0.0	21.2	C		
Northbound												
LTR	0.77	0.42	15.0	1.000	745	0.50	6.4	0.0	21.4	C	21.4	C
Southbound												
LTR	0.90	0.42	16.4	1.000	437	0.50	24.4	0.0	40.7	D	40.7	D

Intersection delay = 25.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	382	5	170
Proportion of LT in LT lane group, PLT	0.000	0.932	0.009	0.431
Proportion of LT in opposing flow, PLTo	0.93	0.00	0.43	0.01
Adjusted opposing flow rate, Vo (veh/h)	410	15	394	570
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	6.37	0.08	2.83
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.83	0.25	6.57	9.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	7.07	0.00	6.71	10.51
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.93	25.00	9.12	14.49
n=Max(gq-gf)/2,0)	3.53	0.00	0.00	5.26
PTHo=1-PLTo	0.07	1.00	0.57	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.93	0.01	0.43
EL1 (refer to Exhibit C16-3)	2.10	1.40	2.07	2.46
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07		1.00	5.16
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.11
gdifff=max(gq-gf,0)	7.07	0.00	0.00	10.51
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72	0.73	1.00	0.51
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.730	0.997	0.506

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	7.07		6.71	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.283		0.268	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	410		394	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.009	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.8	0.00	0.0	0.0	22.7
R	0.0	0.00	17.5	14.5	0.00	0.0	0.0	21.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.0	0.00	0.0	0.0	21.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	16.4	0.00	0.0	0.0	40.7
	0.0						0.0	
Intersection Delay			25.8	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	15			410	384	570		394	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1738			1314	1293	1787		1049	
LnCapacity	724			547	539	745		437	
Flow Ratio	0.0			0.3	0.3	0.3		0.4	
v/c Ratio	0.02			0.75	0.71	0.77		0.90	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.849		0.861		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.1			5.8	5.3	8.1		6.1	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			1.3	1.1	1.8		2.9	
Q Average	0.2			7.1	6.4	9.9		9.0	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.2			8.7	7.9	12.1		11.0	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.5	1.5	1.4		1.4	
BOQ	0.3			10.5	9.5	14.3		13.1	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.6	1.6	1.6		1.6	
BOQ	0.3			11.5	10.5	15.6		14.3	
QSRatio									
95th Percentile Output:									
fB%	2.6			1.8	1.9	1.7		1.8	
BOQ	0.4			13.1	12.0	17.3		15.9	
QSRatio									
98th Percentile Output:									
fB%	3.2			2.1	2.1	1.9		1.9	
BOQ	0.5			14.7	13.6	19.0		17.5	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				437		8		510			559	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2027 0.76 0.33 21.9 C 21.9 C

Northbound

T 1026 2051 0.55 0.50 12.1 B 12.1 B

Southbound

T 1027 2054 0.60 0.50 11.6 B 11.6 B

Intersection Delay = 14.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				437		8	510			559		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				127		2	140			154		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					517		560			614		
%InSharedLn												
Prop LTs					0.983		0.000			0.000		
Prop RTs					0.017		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				437		8	510			559		
PHF				0.86		0.86	0.91			0.91		
Adj flow				508		9	560			614		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					517			560			614	
Prop LTs					0.983			0.000			0.000	
Prop RTs					0.017			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.998			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2027			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	517	2027	# 0.26	0.33	676	0.76
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	560	2051	0.27	0.50	1026	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	614	2054	# 0.30	0.50	1027	0.60
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.76	0.33	17.9	1.000	676	0.50	4.0	0.0	21.9	C	21.9	C	
Northbound													
T	0.55	0.50	10.3	1.000	1026	0.50	1.8	0.0	12.1	B	12.1	B	
Southbound													
T	0.60	0.50	10.7	1.000	1027	0.50	1.0	0.0	11.6	B	11.6	B	

Intersection delay = 14.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.983 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	17.9	0.00	0.0	0.0	21.9
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.3	0.00	0.0	0.0	12.1
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.7	0.00	0.0	0.0	11.6
	0.0						0.0	
Intersection Delay			14.9	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		510	262			175	822	
Peak-Hour Factor, PHF		0.91	0.91			0.91	0.91	
Hourly Flow Rate, HFR		560	287			192	903	
Percent Heavy Vehicles		--	--			6	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		192						
C(m) (vph)		773						
v/c		0.25						
95% queue length		0.98						
Control Delay		11.2						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		510	262	175	822	
Peak-Hour Factor, PHF		0.91	0.91	0.91	0.91	
Peak-15 Minute Volume		140	72	48	226	
Hourly Flow Rate, HFR		560	287	192	903	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		903
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		847						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	847	
Potential Capacity	773	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	773	
Probability of Queue free St.	0.75	1.00
Maj L-Shared Prob Q free St.	0.47	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.47	0.47
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.47 0.47
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.75 0.75
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		192						
C(m) (vph)		773						
v/c		0.25						
95% queue length		0.98						
Control Delay		11.2						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.75
v(i1), Volume for stream 2 or 5		903
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.47
d(M,LT), Delay for stream 1 or 4		11.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		5.9

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				104		197	557	90		138	658	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 393 1475 0.86 0.27 41.0 D 41.0 D

Northbound

TR 1130 1994 0.63 0.57 10.9 B 10.9 B

Southbound

LT 736 1298 1.19 0.57 102.0 F 102.0 F

Intersection Delay = 57.6 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				104		197	557	90		138	658	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				29		55	153	25		38	181	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					338			711			875	
%InSharedLn												
Prop LTs					0.346			0.000			0.174	
Prop RTs					0.654			0.139			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				104		197	557	90		138	658	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				117		221	612	99		152	723	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					338			711			875	
Prop LTs					0.346			0.000			0.174	
Prop RTs					0.654			0.139			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.912			0.981			1.000	
fLT					0.983			1.000			0.638	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1475			1994			1298	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	338	1475	# 0.23	0.27	393	0.86
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	711	1994	0.36	0.57	1130	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	875	1298	# 0.67	0.57	736	1.19
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.90
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.08

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.86	0.27	20.9	1.000	393	0.50	20.1	0.0	41.0	D	41.0	D
Northbound												
TR	0.63	0.57	8.8	1.000	1130	0.50	2.1	0.0	10.9	B	10.9	B
Southbound												
LT	1.19	0.57	13.0	1.000	736	0.50	89.0	0.0	102.0	F	102.0	F

Intersection delay = 57.6 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			152
Proportion of LT in LT lane group, PLT	0.346	0.000	0.174
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			711
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.85
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			2.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.39
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.61
n=Max(gq-gf)/2,0)			3.06
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.17
EL1 (refer to Exhibit C16-3)			2.83
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.64
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.638

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.39
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.247
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				711
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.174
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.654	0.139
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.9	0.00	0.0	0.0	41.0
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.8	0.00	0.0	0.0	10.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	34.8	0.0	102.0
	0.0						0.0	
Intersection Delay			57.6	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	101	45	99	29	88	50	144	707	138	37	560	96
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	509	1478	0.62	0.34	27.5	C	27.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	544	1578	0.42	0.34	25.0	C	25.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	313	575	0.50	0.54	16.0	B		
TR	1065	1957	0.86	0.54	23.0	C	22.0	C

Southbound

LTR	1182	2171	0.62	0.54	16.4	B	16.4	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 21.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	101	45	99	29	88	50	144	707	138	37	560	96
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	32	14	32	10	30	17	39	192	37	10	152	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		314			229		157	918			732	
%InSharedLn												
Prop LTs		0.411			0.175		1.000	0.000			0.055	
Prop RTs		0.404			0.297			0.163			0.113	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	101	45	99	29	88	50	144	707	138	37	560	96
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	129	58	127	40	121	68	157	768	150	40	609	83
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	314			229			157 918			732		
Prop LTs	0.411			0.175			1.000 0.000			0.055		
Prop RTs	0.404			0.297			0.163			0.113		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.945			0.960			0.975			0.983		
fLT	0.726			0.908			0.327 1.000			0.692		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1478			1578			575 1957			2171		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	314	1478	# 0.21	0.34	509	0.62
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	229	1578	0.15	0.34	544	0.42
Right							
Northbound							
Prot							
Perm							
Left	L	157	575	0.27	0.54	313	0.50
Prot							
Perm							
Thru	TR	918	1957	# 0.47	0.54	1065	0.86
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	732	2171	0.34	0.54	1182	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.62	0.34	24.6	1.000	509	0.50	3.0	0.0	27.5	C	27.5	C	
Westbound													
LTR	0.42	0.34	22.6	1.000	544	0.50	2.4	0.0	25.0	C	25.0	C	
Northbound													
L	0.50	0.54	12.8	1.000	313	0.50	3.2	0.0	16.0	B			
TR	0.86	0.54	17.6	1.000	1065	0.50	5.4	0.0	23.0	C	22.0	C	
Southbound													
LTR	0.62	0.54	14.1	1.000	1182	0.50	2.3	0.0	16.4	B	16.4	B	

Intersection delay = 21.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			157	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			732	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			3.93	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.61	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			6.14	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.86	
n=Max(gq-gf)/2,0)			3.07	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.67	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.90	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			6.14	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.33	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.327	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	129	40	40
Proportion of LT in LT lane group, PLT	0.411	0.175	0.000
Proportion of LT in opposing flow, PLTo	0.17	0.41	0.00
Adjusted opposing flow rate, Vo (veh/h)	229	314	918
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	3.23	1.00	1.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.72	7.85	22.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.1	8.1	15.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	6.94	10.18	37.67
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.06	20.82	11.33
n=Max(gq-gf)/2,0)	3.40	1.03	11.19
PTHo=1-PLTo	0.83	0.59	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.41	0.17	0.17
EL1 (refer to Exhibit C16-3)	1.75	1.91	3.45
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.74	1.02	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.08	0.05
gdifff=max(gq-gf,0)	6.79	2.06	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73	0.91	0.47
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726	0.908	0.692

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	6.94	10.18	6.14	37.67
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.224	0.328	0.125	0.769
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	229	314	732	918
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.411	0.175	1.000	0.055
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.404	0.297	0.163	0.113
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.6	0.00	0.0	0.0 0.0 0.0	27.5
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	22.6	0.00	0.0	0.0 0.0 0.0	25.0
Northbound								
L	0.0	0.00	20.5	12.8	0.00	0.0	0.0	16.0
TR	0.0 0.0	0.00	20.5	17.6	0.00	0.0	0.0 0.0	23.0
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	14.1	0.00	0.0	0.0 0.0 0.0	16.4
Intersection Delay			21.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	314		229		157	918	384	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1478		1578		575	1957	1140	
LnCapacity	509		544		313	1065	620	
Flow Ratio	0.2		0.1		0.3	0.5	0.3	
v/c Ratio	0.62		0.42		0.50	0.86	0.62	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.5		4.4		2.5	19.7	6.6	
kB	0.4		0.7		0.3	0.7	0.8	
Q2	0.6		0.5		0.3	3.5	1.2	
Q Average	7.1		4.9		2.7	23.2	7.8	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	8.7		6.1		3.4	27.9	9.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	10.5		7.4		4.3	32.6	11.4	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.7		1.8	1.5	1.6	
BOQ	11.6		8.3		4.9	34.9	12.6	
QSRatio								
95th Percentile Output:								
fB%	1.8		2.0		2.2	1.6	1.8	
BOQ	13.1		9.7		6.0	37.4	14.2	
QSRatio								
98th Percentile Output:								
fB%	2.1		2.3		2.6	1.7	2.0	
BOQ	14.7		11.1		7.0	39.8	15.8	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	381						857			637		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.66	0.33	30.8	C	30.8	C

Westbound

Northbound

T 2134 3842 0.42 0.56 11.9 B 11.9 B

Southbound

T 1951 3512 0.35 0.56 11.6 B 11.6 B

Intersection Delay = 15.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	381						857			637		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	111						223			173		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	443						893			692		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	381						857			637		
PHF	0.86						0.96			0.92		
Adj flow	443						893			692		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	443						893			692		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.980				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3842				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	443	2006	# 0.22	0.33	669	0.66
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	893	3842	# 0.23	0.56	2134	0.42
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	692	3512	0.20	0.56	1951	0.35
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.45$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.51$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.66	0.33	25.7	1.000	669	0.50	5.1	0.0	30.8	C	30.8	C	
Westbound													
Northbound													
T	0.42	0.56	11.6	1.000	2134	0.50	0.3	0.0	11.9	B	11.9	B	
Southbound													
T	0.35	0.56	11.1	1.000	1951	0.50	0.5	0.0	11.6	B	11.6	B	

Intersection delay = 15.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	25.7	0.00	0.0	0.0	30.8
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.6	0.00	0.0	0.0	11.9
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.1	0.00	0.0	0.0	11.6
	0.0						0.0	
Intersection Delay			15.9	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	443						469		363	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2017		1844	
LnCapacity	669						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.66						0.42		0.35	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.567		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	9.5						6.8		5.0	
kB	0.9						0.7		1.1	
Q2	1.6						0.5		0.6	
Q Average	11.1						7.3		5.6	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	13.4						8.9		6.9	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	15.9						10.7		8.4	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	17.2						11.8		9.4	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	18.9						13.4		10.8	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.0		2.2	
BOQ	20.6						14.9		12.3	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					637	
Peak-Hour Factor, PHF					0.92	
Peak-15 Minute Volume					173	
Hourly Flow Rate, HFR					692	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						55
Peak Hour Factor, PHF						0.88
Peak-15 Minute Volume						16
Hourly Flow Rate, HFR						62
Percent Heavy Vehicles						5
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								346
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		346
Potential Capacity		690
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		690
Probability of Queue free St.	1.00	0.91
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	448
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	448
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	448	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	448	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	500
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	500

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	721	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity	656	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						62
Movement Capacity (vph)						690
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						690
Volume						62
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								62
C(m) (vph)								690
v/c								0.09
95% queue length								0.30
Control Delay								10.7
LOS								B
Approach Delay							10.7	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Saturday 12:45-1:45 PM MD Peak

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island

Year : 2015 No-Action Conditions

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	96	296	209	263	609	46	150	139	212	43	96	89
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left		P	
	Thru	P				Thru		P	
	Right	P				Right		P	
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		30.0					25.0	20.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	112	336	0.92	0.33	81.3	F		
TR	594	1782	0.83	0.33	36.7	D	44.4	D
Westbound								
L	125	362	2.19	0.34	588.8	F		
TR	1200	3484	0.69	0.34	28.3	C	167.9	F
Northbound								
LTR	933	3360	0.60	0.28	31.0	C	31.0	C
Southbound								
L	384	1728	0.13	0.22	28.7	C		
TR	362	1629	0.61	0.22	37.8	D	36.1	D

Intersection Delay = 94.4 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	96	296	209	263	609	46	150	139	212	43	96	89
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	26	80	56	68	195	15	42	39	59	13	29	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	103	491		274	826			557		51	220	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.300			0.000	
Prop RTs		0.352			0.054			0.424			0.482	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	96	296	209	263	609	46	150	139	212	43	96	89
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	103	318	173	274	781	45	167	154	236	51	114	106
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	103	491		274	826			557		51	220	
Prop LTs	1.000	0.000		1.000	0.000			0.300			0.000	
Prop RTs		0.352			0.054			0.424			0.482	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.947			0.992		0.936				0.928	
fLT	0.185	1.000		0.195	1.000		0.985			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	336	1782		362	3484		3360			1728	1629	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	103	336	0.31	0.33	112	0.92
Prot							
Perm							
Thru	TR	491	1782	0.28	0.33	594	0.83
Right							
Westbound							
Prot							
Perm							
Left	L	274	362	# 0.76	0.34	125	2.19
Prot							
Perm							
Thru	TR	826	3484	0.24	0.34	1200	0.69
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	557	3360	# 0.17	0.28	933	0.60
Right							
Southbound							
Prot							
Perm							
Left	L	51	1728	0.03	0.22	384	0.13
Prot							
Perm							
Thru	TR	220	1629	# 0.14	0.22	362	0.61
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.06$
Total lost time per cycle, $L = 14.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.25$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.92	0.33	28.8	1.000	112	0.50	52.5	0.0	81.3	F		
TR	0.83	0.33	27.6	1.000	594	0.50	9.1	0.0	36.7	D	44.4	D
Westbound												
L	2.19	0.34	29.5	1.000	125	0.50	559.3	0.0	588.8	F		
TR	0.69	0.34	25.3	1.000	1200	0.50	2.9	0.0	28.3	C	167.9	F
Northbound												
LTR	0.60	0.28	28.1	1.000	933	0.50	2.8	0.0	31.0	C	31.0	C
Southbound												
L	0.13	0.22	28.1	1.000	384	0.50	0.6	0.0	28.7	C		
TR	0.61	0.22	31.5	1.000	362	0.50	6.4	0.0	37.8	D	36.1	D

Intersection delay = 94.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	103	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	826	491		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.58	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.85	12.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	13.74	18.51		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.26	12.49		
n=Max(gq-gf)/2,0)	6.87	9.25		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.93	2.07		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.18	0.20		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.185	0.195		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.300 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	13.74			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.458			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	826			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.054
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	28.8	0.00	0.0	0.0	81.3
TR	0.0	0.00	30.0	27.6	0.00	0.0	0.0	36.7
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	37.2	0.0	588.8
TR	0.0	0.00	29.5	25.3	0.00	0.0	0.0	28.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.1	0.00	0.0	0.0	31.0
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.1	0.00	0.0	0.0	28.7
TR	0.0	0.00	35.0	31.5	0.00	0.0	0.0	37.8
	0.0						0.0	

Intersection Delay	94.4	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	103	491		274	433		292			51	220	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	336	1782		362	1829		1764			1728	1629	
LnCapacity	112	594		125	630		490			384	362	
Flow Ratio	0.3	0.3		0.8	0.2		0.2			0.0	0.1	
v/c Ratio	0.92	0.83		2.19	0.69		0.60			0.13	0.61	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.5	11.3		6.8	9.3		6.3			1.0	4.9	
kB	0.2	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	1.0	2.3		19.1	1.5		1.0			0.1	0.7	
Q Average	3.5	13.5		25.9	10.8		7.3			1.1	5.7	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	4.4	16.3		31.1	13.1		8.9			1.4	7.0	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.4		1.5			1.6	1.5	
BOQ	5.4	19.2		36.3	15.5		10.7			1.8	8.5	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5		1.5	1.6		1.6			1.9	1.7	
BOQ	6.1	20.8		38.9	16.9		11.8			2.1	9.4	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7		1.6	1.7		1.8			2.4	1.9	
BOQ	7.3	22.6		41.6	18.6		13.4			2.6	10.9	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.8		1.7	1.9		2.0			2.9	2.2	
BOQ	8.6	24.4		44.3	20.3		15.0			3.2	12.4	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						567	
Peak-Hour Factor, PHF						0.93	
Hourly Flow Rate, HFR						609	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Undivided		/			
RT Channelized?							
Lanes						1	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume		173					
Peak Hour Factor, PHF		0.90					
Hourly Flow Rate, HFR		192					
Percent Heavy Vehicles		1					
Percent Grade (%)			0			0	
Flared Approach: Exists?/Storage					/		/
Lanes		1					
Configuration		L					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			192					
C(m) (vph)			460					
v/c			0.42					
95% queue length			2.03					
Control Delay			18.3					
LOS			C					
Approach Delay				18.3				
Approach LOS				C				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 567
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 152
 Hourly Flow Rate, HFR 609
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 173
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 48
 Hourly Flow Rate, HFR 192
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	609	
Potential Capacity	460	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	460	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 609
Potential Capacity 460
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 460

Results for Two-stage process:
a
y
C t 460

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	192					
Movement Capacity (vph)	460					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	460					
Volume	192					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			192					
C(m) (vph)			460					
v/c			0.42					
95% queue length			2.03					
Control Delay			18.3					
LOS			C					
Approach Delay				18.3				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	193	32	107	173	0	55	0	92	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.85	0.85	0.91	0.91	0.89	0.89		
Flow Rate	112	151	211	95	61	103		
% Heavy Veh	0	0	0	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	112	151	211	95	61	103		
Left-Turn	0	0	117	0	61	0		
Right-Turn	0	37	0	0	0	103		
Prop. Left-Turns	0.0	0.0	0.6	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.2	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	112	151	211	95	61	103		
Service Time	2.9	2.8	3.2	2.9	3.4	2.6		
Utilization, x	0.16	0.21	0.32	0.14	0.09	0.13		
Dep. headway, hd	5.23	5.06	5.45	5.19	5.41	4.61		
Capacity	362	401	461	345	311	353		
Delay	8.95	9.12	10.70	8.72	8.95	8.31		
LOS	A	A	B	A	A	A		
Approach:								
Delay		9.05		10.08		8.55		
LOS		A		B		A		
Intersection Delay	9.37				Intersection LOS	A		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	79	147	284	229	512	24	253	200	112	25	521	162
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 824 3225 0.67 0.26 33.8 C 33.8 C

Westbound

LTR 898 3512 1.09 0.26 90.1 F 90.1 F

Northbound

DefL 140 436 1.92 0.32 470.4 F
 TR 593 1839 0.58 0.32 29.5 C 223.3 F

Southbound

LTR 962 2984 0.79 0.32 34.4 C 34.4 C

Intersection Delay = 92.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	147	284	229	512	24	253	200	112	25	521	162
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	21	40	77	73	164	8	67	55	31	7	140	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		555			981		269	343			761	
%InSharedLn												
Prop LTs		0.155			0.300		1.000	0.000			0.035	
Prop RTs		0.557			0.032			0.359			0.229	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	147	284	229	512	24	253	200	112	25	521	162
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	86	160	309	294	656	31	269	220	123	27	560	174
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	555			981			269 343			761		
Prop LTs	0.155			0.300			1.000 0.000			0.035		
Prop RTs	0.557			0.032			0.359			0.229		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.916			0.995			0.946			0.966		
fLT	0.992			0.985			0.208 1.000			0.932		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3225			3512			436 1839			2984		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	555	3225	# 0.17	0.26	824	0.67
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	981	3512	# 0.28	0.26	898	1.09
Right							
Northbound							
Prot							
Perm							
Left	DefL	269	436	# 0.62	0.32	140	1.92
Prot							
Perm							
Thru	TR	343	1839	0.19	0.32	593	0.58
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	761	2984	0.26	0.32	962	0.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.07
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.67	0.26	30.1	1.000	824	0.50	3.7	0.0	33.8	C	33.8	C
Westbound												
LTR	1.09	0.26	33.5	1.000	898	0.50	56.6	0.0	90.1	F	90.1	F
Northbound												
DefL	1.92	0.32	30.5	1.000	140	0.50	439.9	0.0	470.4	F		
TR	0.58	0.32	25.4	1.000	593	0.50	4.1	0.0	29.5	C	223.3	F
Southbound												
LTR	0.79	0.32	27.7	1.000	962	0.50	6.6	0.0	34.4	C	34.4	C

Intersection delay = 92.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			269	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			761	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			6.73	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.99	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			12.41	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.59	
n=Max(gq-gf)/2,0)			6.21	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.75	
EL2=Max((1-Ptho**n)/Plto, 1.0)			5.66	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			12.41	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.21	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.208	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	27
Proportion of LT in LT lane group, PLT	0.155 0.300 0.000 0.035
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	343
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.68
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.29
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	1.42
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.09
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	1.97
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.932

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				1.42
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.049
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				343
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.035
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.557	0.032	0.359
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	30.1	0.00	0.0	0.0	33.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	20.7	0.0	90.1
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	32.3	0.0	470.4
TR	0.0	0.00	30.5	25.4	0.00	0.0	0.0	29.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	27.7	0.00	0.0	0.0	34.4
	0.0						0.0	
Intersection Delay			92.8	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	291		515		269	343	399	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0
SL	1693		1844		436	1839	1567	
LnCapacity	432		471		140	593	505	
Flow Ratio	0.2		0.3		0.6	0.2	0.3	
v/c Ratio	0.67		1.09		1.92	0.58	0.79	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.5		12.9		6.7	7.1	9.1	
kB	0.5		0.6		0.3	0.8	0.7	
Q2	1.0		9.5		16.7	1.1	2.3	
Q Average	7.6		22.3		23.4	8.2	11.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	9.3		26.8		28.1	10.0	13.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.4	1.5	1.4	
BOQ	11.1		31.4		32.9	11.9	16.2	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.5		1.5	1.6	1.6	
BOQ	12.2		33.6		35.3	13.1	17.6	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.6		1.6	1.8	1.7	
BOQ	13.8		36.0		37.7	14.7	19.3	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.7		1.7	2.0	1.9	
BOQ	15.4		38.4		40.2	16.3	21.0	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Sat Flw Rate EB-L = 2100
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2015 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	849	389			431	597				175		206
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Phase Combination		1	2	3	4	Signal Operations				
EB	Left	P	P			NB	Left			
	Thru	P	P				Thru			
	Right						Right			
	Peds						Peds			
WB	Left					SB	Left	P		
	Thru		P				Thru			
	Right		P				Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right			
Green		37.0	22.0					16.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	895	1909	0.98	0.72	37.8	D		
T	1170	1646	0.35	0.71	5.4	A	27.6	C

T	460	1881	1.00	0.24	51.1	D	190.2	F
R	391	1599	1.57	0.24	294.0	F		

Southbound								
L	576	3239	0.33	0.18	33.8	C	19.5	B

Intersection Delay = 89.5 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	849	389			431	597				175		206
% Heavy Veh	1	1			1	1				1		1
PHF	0.97	0.96			0.94	0.97				0.92		0.92
PK 15 Vol	219	101			115	154				48		56
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat	2100	1900			1900	1900				1900		1900
ParkExist												
NumPark			X									
			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0
Adj Flow	875	405			459	615				190		224
%InSharedLn												
Prop LTs	1.000	0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0		0			0		
Buses	0	0			0	0				0		0
%InProtPhase	50.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0				0.0		0.0
Arriv. Type	3	3			3	3				3		3
Unit Ext.	3.0	3.0			3.0	3.0				3.0		3.0
I Factor		0.508			0.176						1.000	
Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Ext of g	3.0	2.0			2.0	2.0				2.0		2.0
Ped Min g					24.6			3.2			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	849	389			431	597							175		206
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	875	405			459	615							190		224
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T	R		L	T	R
Adj flow	875	405			459	615			190				190		224
Prop LTs	1.000	0.000			0.000										
Prop RTs		0.000			0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T	R		L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0				2	0	1
fW	0.967	1.000			1.000	1.000			0.933				0.933		0.933
fHV	0.990	0.990			0.990	0.990			0.990				0.990		0.990
fG	1.000	1.000			1.000*1.000*				1.000				1.000		1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000		1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000		1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000		1.000
fLU	1.000	1.000			1.000	1.000			0.971				0.971		1.000
fRT		1.000			1.000	0.850									0.850
fLT	0.950	1.000			1.000				0.950				0.950		
Sec.	0.148														
fLpb	1.000	1.000			1.000				1.000				1.000		
fRpb		1.000			1.000	1.000									1.000
S	1909	1646			1881	1599			3239				3239		1492
Sec.	298														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

R 0.23 0.64 6.7 1.000 962 0.50 0.6 0.0 7.3 A

Intersection delay = 89.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)	64.0			
Effective permitted green time for LT lane group, g(s)	27.0			
Opposing effective green time, go (s)	22.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	875			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	459			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLT/C	21.88			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.48			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			
gq, (see Exhibit C16-4,5,6,7,8)	23.28			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	3.72			
n=Max(gq-gf)/2,0)	11.64			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.01			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

-----SUPPLEMENTAL UNIFORM DELAY WORKSHEET-----

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	875			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	19.28			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	28.7			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.24			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.51			
XPerm	2.77			
XProt	0.80			
Case	3			
Queue at beginning of green arrow, Qa	10.59			
Queue at beginning of unsaturated green, Qu	4.68			
Residual queue, Qr	3.61			
Uniform Delay, d1	21.1			

-----DELAY/LOS WORKSHEET WITH INITIAL QUEUE-----

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.1	0.00	0.0	0.0	37.8
T	0.0	0.00	13.0	5.0	0.00	0.0	0.0	5.4
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	34.0	34.0	0.00	0.0	0.0	51.1
R	0.0	0.00	34.0	34.0	0.00	56.0	0.0	294.0
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.3	0.00	0.0	0.0	33.8
	0.0						0.0	
R	0.0	0.00	16.0	6.7	0.00	0.0	0.0	7.3
Intersection Delay			89.5	sec/veh	Intersection LOS F			

-----BACK OF QUEUE WORKSHEET-----

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	875	405		459	615				97	224
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1240	1646		1881	1599				1668	1492
LnCapacity	895	1170		460	391				296	962
Flow Ratio	0.7	0.2		0.2	0.4				0.1	0.2
v/c Ratio	0.98	0.35		1.00	1.57				0.33	0.23
Grn Ratio	0.72	0.71		0.24	0.24				0.18	0.64
I Factor		0.508		0.176						1.000
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00	1.00				1.00	1.00
Q1	10.3	3.9		11.5	15.4				2.1	2.3
kB	0.5	0.6		0.1	0.1				0.5	1.1
Q2	6.5	0.3		2.5	28.3				0.2	0.3
Q Average	16.9	4.2		14.0	43.7				2.4	2.7
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2				1.3	1.3
BOQ	20.3	5.2		16.9	52.4				3.0	3.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4				1.6	1.6
BOQ	23.8	6.5		19.8	61.1				3.7	4.2
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5				1.8	1.8
BOQ	25.6	7.2		21.4	65.5				4.3	4.8
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7	1.6				2.2	2.2
BOQ	27.6	8.6		23.2	69.9				5.2	5.9
QSRatio										
98th Percentile Output:										
fB%	1.8	2.3		1.8	1.7				2.6	2.6
BOQ	29.5	9.9		25.1	74.2				6.2	6.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2015 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	521	45	0	0	45	56	0	0	1	81	0	983
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	738	1476	0.74	0.50	24.0	C		
TR	1066	2132	0.04	0.50	11.6	B	23.0	C

LTR	1633	3266	0.06	0.50	11.7	B	11.7	B
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	546	1403	0.16	0.39	18.4	B	58.2	E
R	622	1599	1.01	0.39	63.7	E		

Intersection Delay = 40.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	521	45	0	0	45	56	0	0	1	81	0	983
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	136	12	0	0	12	15	0	0	1	22	0	264
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	543	47			95			1			87	629
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0		0	0	
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.967		1.000			1.000			0.855		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3		17.5			20.3			20.3		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	521	45	0	0	45	56	0	0	1	81	0	983
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	543	47	0	0	49	46	0	0	1	87	0	629
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	543	47			95			1			87	629
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.692	1.000		1.000			1.000			0.746	
Sec.											
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	1476	2132		3266			3045			1403	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	543	1476	# 0.37	0.50	738	0.74
Prot							
Perm							
Thru	TR	47	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	95	3266	0.03	0.50	1633	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	87	1403	0.06	0.39	546	0.16
Right	R	629	1599	# 0.39	0.39	622	1.01

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.76$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.86$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.74	0.50	17.8	1.000	738	0.50	6.2	0.0	24.0	C		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	23.0	C
Westbound												
LTR	0.06	0.50	11.6	1.000	1633	0.50	0.1	0.0	11.7	B	11.7	B
Northbound												
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B
Southbound												
LT	0.16	0.39	17.9	1.000	546	0.50	0.5	0.0	18.4	B	58.2	E

R 1.01 0.39 27.5 1.000 622 0.50 36.2 0.0 63.7 E

Intersection delay = 40.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	543			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	95			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	13.58			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.25			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.44			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.692			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	87
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	47	87	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.17
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.59	2.17	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.49
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	95	47	87	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.484	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	17.8	0.00	0.0	0.0	24.0
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.9	0.00	0.0	0.0	18.4
R	0.0	0.00	27.5	27.5	0.00	1.8	0.0	63.7
Intersection Delay			40.2	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	543	47			49				0				87	629	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1476	2132			1715				1599				1403	1599	
LnCapacity	738	1066			857				621				546	622	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.4	
v/c Ratio	0.74	0.04			0.06				0.00				0.16	1.01	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	10.7	0.6			0.6				0.0				1.4	15.7	
kB	0.9	1.2			1.0				0.8				0.6	0.7	
Q2	2.3	0.1			0.1				0.0				0.1	7.9	
Q Average	13.0	0.7			0.7				0.0				1.5	23.6	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	15.7	0.8			0.9				0.0				2.0	28.3	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	18.5	1.1			1.2				0.0				2.5	33.1	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	20.0	1.3			1.3				0.0				2.9	35.5	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.3	1.6	
BOQ	21.8	1.6			1.7				0.0				3.6	38.0	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			3.0				3.2				2.8	1.7	
BOQ	23.6	2.0			2.1				0.0				4.3	40.4	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	250		34				5	279			731	506
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.51	0.32	19.6	B	19.2	B
R	497	1568	0.06	0.32	14.5	B		
Westbound								

Northbound

LT 1692 3274 0.19 0.52 8.0 A 8.0 A

Southbound

TR 1968 3810 0.71 0.52 12.1 B 12.1 B

Intersection Delay = 12.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	250		34				5	279		731	506	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	74		10				2	79		205	142	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	294		29					323			1390	
%InSharedLn												
Prop LTs								0.019			0.000	
Prop RTs			1.000					0.000			0.409	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	250		34				5	279		731	506	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	294		29				6	317		821	569	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	294		29					323			1390	
Prop LTs								0.019			0.000	
Prop RTs			1.000					0.000			0.409	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.971	0.971			0.990	0.990		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.939		
fLT	0.950				0.930	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1811	1568			3274	3810		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	294	1811	# 0.16	0.32	573	0.51
Prot							
Perm							
Thru							
Right	R	29	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	323	3274	0.10	0.52	1692	0.19
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1390	3810	# 0.36	0.52	1968	0.71
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.51	0.32	16.7	1.000	573	0.50	2.9	0.0	19.6	B	19.2	B	
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B			
Westbound													
Northbound													
LT	0.19	0.52	7.8	1.000	1692	0.50	0.2	0.0	8.0	A	8.0	A	
Southbound													
TR	0.71	0.52	11.0	1.000	1968	0.50	1.1	0.0	12.1	B	12.1	B	

Intersection delay = 12.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.019 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1390
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.17
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	14.79
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.83
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	5.77
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.930

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.79	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.477	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1390	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.019	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.409
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	16.7	0.00	0.0	0.0	19.6
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.8	0.00	0.0	0.0	8.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.0	0.00	0.0	0.0	12.1
	0.0						0.0	
Intersection Delay			12.6	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	294	29				169		730	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1719		2001	
LnCapacity	573	497				888		1033	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.51	0.06				0.19		0.71	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	4.0	0.3				1.5		9.3	
kB	0.5	0.5				0.8		0.4	
Q2	0.5	0.0				0.2		1.0	
Q Average	4.5	0.4				1.7		10.3	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	5.6	0.5				2.2		12.5	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	6.9	0.6				2.7		14.8	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.6	
BOQ	7.7	0.7				3.1		16.1	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.5				2.3		1.7	
BOQ	9.1	0.9				3.9		17.7	
QSRatio									
98th Percentile Output:									
fB%	2.3	3.1				2.8		1.9	
BOQ	10.5	1.1				4.7		19.4	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			LT			L	LTR				
Volume	1	0		685	2		5			27	552	1
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	606	1454	0.93	0.42	39.4	D		
LT	582	1397	0.33	0.42	13.3	B	32.9	C

Northbound

L	255	613	0.02	0.42	10.5	B	10.5	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2039	4893	0.32	0.42	12.2	B	12.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 23.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		685	2		5			27	552	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		188	1		2			8	155	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			565	190		6			651		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.991		1.000				0.046	
Prop RTs	0.000			0.000						0.002		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		685	2		5			27	552	1
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	4	0		753	2		6			30	620	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			565	190		6			651		
Prop LTs	0.000			1.000 0.991			1.000			0.046		
Prop RTs	0.000			0.000						0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.726		0.346		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1454 1397		613		4893	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	565	1454	# 0.39	0.42	606	0.93
Prot							
Perm							
Thru	LT	190	1397	0.14	0.42	582	0.33
Right							
Northbound							
Prot							
Perm							
Left	L	6	613	0.01	0.42	255	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	651	4893	# 0.13	0.42	2039	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.93	0.42	16.7	1.000	606	0.50	22.7	0.0	39.4	D			
LT	0.33	0.42	11.8	1.000	582	0.50	1.4	0.0	13.3	B	32.9	C	
Northbound													
L	0.02	0.42	10.3	1.000	255	0.50	0.2	0.0	10.5	B	10.5	B	
Southbound													
LTR	0.32	0.42	11.8	1.000	2039	0.50	0.4	0.0	12.2	B	12.2	B	

Intersection delay = 23.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		565	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.05	
Adjusted opposing flow rate, Vo (veh/h)		4	651	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/3600		9.42	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.98	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	3.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	22.00	
n=Max(gq-gf)/2,0)		0.00	1.50	
PTHo=1-PLTo		1.00	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.55	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.48	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	3.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.35	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.346	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	188		
Proportion of LT in LT lane group, PLT	0.000	0.991	0.046
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.13		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L	LTR		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	4		565	190	6	238		
So	1900		1900	1900	1900	1900		
No.Lanes	0	1	0	1	0	0	3	
SL	1881		1454	1397	613	1796		
LnCapacity	784		606	582	255	748		
Flow Ratio	0.0		0.4	0.1	0.0	0.1		
v/c Ratio	0.01		0.93	0.33	0.02	0.32		
Grn Ratio	0.42		0.42	0.42	0.42	0.42		
I Factor	1.000		0.971		0.951		1.000	
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	0.0		9.0	2.1	0.1	2.7		
kB	0.7		0.6	0.6	0.3	0.7		
Q2	0.0		4.4	0.3	0.0	0.3		
Q Average	0.0		13.4	2.4	0.1	3.0		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3	1.3		
BOQ	0.1		16.1	3.0	0.1	3.8		
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7	1.6		
BOQ	0.1		19.0	3.8	0.1	4.7		
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0	1.8		
BOQ	0.1		20.5	4.4	0.1	5.3		
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	2.2	2.6	2.1		
BOQ	0.1		22.3	5.4	0.2	6.4		
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2	2.5		
BOQ	0.1		24.1	6.3	0.2	7.6		
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	28
Peak-Hour Factor, PHF	0.69
Hourly Flow Rate, HFR	40
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	524
Peak Hour Factor, PHF	0.88
Hourly Flow Rate, HFR	595
Percent Heavy Vehicles	0
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	595
C(m) (vph)	1037
v/c	0.57
95% queue length	3.78
Control Delay	13.0
LOS	B
Approach Delay	13.0
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		28				
Peak-Hour Factor, PHF		0.69				
Peak-15 Minute Volume		10				
Hourly Flow Rate, HFR		40				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			524			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			149			
Hourly Flow Rate, HFR			595			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					40			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	40	
Potential Capacity	1037	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1037	
Probability of Queue free St.	0.43	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.43
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.43
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			595			
Movement Capacity (vph)			1037			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1037			
Volume			595			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					595			
C(m) (vph)					1037			
v/c					0.57			
95% queue length					3.78			
Control Delay					13.0			
LOS					B			
Approach Delay				13.0				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	75	34	192	58	0	0	0	0	17	116	22
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.75		0.85				0.89 0.89	
Flow Rate	145		293				84 89	
% Heavy Veh	2		4				0 0	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	145		293				84	89
Left-Turn	0		225				19	0
Right-Turn	45		0				0	24
Prop. Left-Turns	0.0		0.8				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	66	0	0	198	23	51	103	135	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	121		259		106		196	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	121		259		106	196		
Left-Turn	33		0		53	0		
Right-Turn	0		27		0	142		
Prop. Left-Turns	0.3		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	-0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	121		259		106	196		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.11		0.23		0.09	0.17		
hd, final value	5.00		4.71		4.95	4.42		
x, final value	0.17		0.34		0.15	0.24		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.0		2.7		3.0	2.4		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	121		259		106	196		
Service Time	3.0		2.7		3.0	2.4		
Utilization, x	0.17		0.34		0.15	0.24		
Dep. headway, hd	5.00		4.71		4.95	4.42		
Capacity	371		509		356	446		
Delay	9.00		10.10		8.80	8.81		
LOS	A		B		A	A		
Approach:								
Delay		9.00		10.10		8.80		
LOS		A		B		A		
Intersection Delay	9.33							

Intersection LOS A

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	211	203	137	0	61	15	625	63	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	539	1540	1.02	0.35	64.5	E	57.1	E
R	560	1599	0.17	0.35	14.1	B		

Westbound

LTR	557	1591	0.16	0.35	14.1	B	14.1	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2267	4690	0.33	0.48	9.9	A	9.9	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 30.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	211	203	137	0	61	15	625	63	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	70	68	46	0	18	5	168	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		552	95		91			743				
%InSharedLn												
Prop LTs		0.509			0.000			0.904				
Prop RTs		0.000	1.000		0.198			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0						29.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	211	203	137	0	61	15	625	63	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	281	271	95	0	73	18	672	68	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		552	95		91			743				
Prop LTs		0.509			0.000			0.904				
Prop RTs		0.000	1.000		0.198			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.973			0.999	
fLT	0.792			1.000			0.957	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1540	1599		1591			4690	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.02	0.35	19.5	1.000	539	0.50	45.0	0.0	64.5	E	57.1	E
R	0.17	0.35	13.5	1.000	560	0.50	0.7	0.0	14.1	B		
Westbound												
LTR	0.16	0.35	13.4	1.000	557	0.50	0.6	0.0	14.1	B	14.1	B
Northbound												
LTR	0.33	0.48	9.5	1.000	2267	0.50	0.4	0.0	9.9	A	9.9	A
Southbound												

Intersection delay = 30.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo 1.000 1.000 0.908

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho*n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s) 21.0 21.0

Effective permitted green time for LT lane group, g(s) 21.0 21.0

Opposing effective green time, go (s) 21.0 21.0

Number of lanes in LT lane group, N 1 1

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	281	0	
Proportion of LT in LT lane group, PLT	0.509	0.000	0.904
Proportion of LT in opposing flow, PLTo	0.00	0.51	
Adjusted opposing flow rate, Vo (veh/h)	91	552	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.68	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.52	9.20	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	11.98	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	9.02	
n=Max(gq-gf)/2,0)	0.00	5.99	
PTHo=1-PLTo	1.00	0.49	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51	0.00	
EL1 (refer to Exhibit C16-3)	1.52	2.42	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.94	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	11.98	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.79	0.43	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.792	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	11.98		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.570		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	91	552	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.509	0.000	0.904	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.198	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	3.3	0.0	64.5
R	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.4	0.00	0.0	0.0	14.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.5	0.00	0.0	0.0	9.9
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			30.8	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound	Northbound		Southbound		
LaneGroup	LT	R	LTR	LTR				
Init Queue	0.0	0.0	0.0	0.0				
Flow Rate	552	95	91	272				
So	1900	1900	1900	1900				
No.Lanes	0 1	1	0 1	0 3	0	0	0	
SL	1540	1599	1591	1721				
LnCapacity	539	560	557	832				
Flow Ratio	0.4	0.1	0.1	0.2				
v/c Ratio	1.02	0.17	0.16	0.33				
Grn Ratio	0.35	0.35	0.35	0.48				
I Factor	0.997		0.993	0.967				
AT or PVG	3	3	3	3				
Pltn Ratio	1.00	1.00	1.00	1.00				
PF2	1.00	1.00	1.00	1.00				
Q1	9.2	1.1	1.0	2.8				
kB	0.6	0.6	0.6	0.7				
Q2	7.1	0.1	0.1	0.4				
Q Average	16.3	1.2	1.2	3.1				
Q Spacing	25.0	25.0	25.0	25.0				
Q Storage	0	0	0	0				
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3	1.3				
BOQ	19.6	1.5	1.5	3.9				
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6	1.6				
BOQ	23.0	2.0	1.9	4.9				
QSRatio								
90th Percentile Output:								
fB%	1.5	1.9	1.9	1.8				
BOQ	24.7	2.3	2.2	5.5				
QSRatio								
95th Percentile Output:								
fB%	1.6	2.4	2.4	2.1				
BOQ	26.6	2.9	2.8	6.7				
QSRatio								
98th Percentile Output:								
fB%	1.8	2.9	2.9	2.5				
BOQ	28.6	3.5	3.3	7.8				
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	211	203	137	0	61	15	625	63	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	539	1540	1.02	0.35	64.5	E	57.1	E
R	560	1599	0.17	0.35	14.1	B		

Westbound

LTR	557	1591	0.16	0.35	14.1	B	14.1	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2267	4690	0.33	0.48	9.9	A	9.9	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 30.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	211	203	137	0	61	15	625	63	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	70	68	46	0	18	5	168	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		552	95		91			743				
%InSharedLn												
Prop LTs		0.509			0.000			0.904				
Prop RTs		0.000	1.000		0.198			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	211	203	137	0	61	15	625	63	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	281	271	95	0	73	18	672	68	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	552 95			91			743					
Prop LTs	0.509			0.000			0.904					
Prop RTs	0.000 1.000			0.198			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.973			0.999	
fLT	0.792			1.000			0.957	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1540	1599		1591			4690	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.02	0.35	19.5	1.000	539	0.50	45.0	0.0	64.5	E	57.1	E
R	0.17	0.35	13.5	1.000	560	0.50	0.7	0.0	14.1	B		
Westbound												
LTR	0.16	0.35	13.4	1.000	557	0.50	0.6	0.0	14.1	B	14.1	B
Northbound												
LTR	0.33	0.48	9.5	1.000	2267	0.50	0.4	0.0	9.9	A	9.9	A
Southbound												

Intersection delay = 30.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	281	0	
Proportion of LT in LT lane group, PLT	0.509	0.000	0.904
Proportion of LT in opposing flow, PLTo	0.00	0.51	
Adjusted opposing flow rate, Vo (veh/h)	91	552	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.68	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.52	9.20	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	11.98	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	9.02	
n=Max(gq-gf)/2,0)	0.00	5.99	
PTHo=1-PLTo	1.00	0.49	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51	0.00	
EL1 (refer to Exhibit C16-3)	1.52	2.42	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.94	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	11.98	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.79	0.43	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.792	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	11.98		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.570		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	91	552	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.509	0.000	0.904	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.198	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	3.3	0.0	64.5
R	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.4	0.00	0.0	0.0	14.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.5	0.00	0.0	0.0	9.9
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			30.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	552	95	91		272			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1540	1599	1591		1721			
LnCapacity	539	560	557		832			
Flow Ratio	0.4	0.1	0.1		0.2			
v/c Ratio	1.02	0.17	0.16		0.33			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.997		0.993		0.967			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	9.2	1.1	1.0		2.8			
kB	0.6	0.6	0.6		0.7			
Q2	7.1	0.1	0.1		0.4			
Q Average	16.3	1.2	1.2		3.1			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.3			
BOQ	19.6	1.5	1.5		3.9			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.6			
BOQ	23.0	2.0	1.9		4.9			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.9	1.9		1.8			
BOQ	24.7	2.3	2.2		5.5			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.4	2.4		2.1			
BOQ	26.6	2.9	2.8		6.7			
QSRatio								
98th Percentile Output:								
fB%	1.8	2.9	2.9		2.5			
BOQ	28.6	3.5	3.3		7.8			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Sharrots Road

Inter.: Sharrots Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 No-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Volume	138		65				42	436			371	179
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	575	1726	0.47	0.33	18.4	B	18.4	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	859	1717	0.61	0.50	13.4	B	13.4	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	1023	2046	0.57	0.50	12.6	B	12.6	B
----	------	------	------	------	------	---	------	---

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	138		65				42	436		371	179	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	46		22				11	118		102	49	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		271						520			583	
%InSharedLn												
Prop LTs		0.679						0.088			0.000	
Prop RTs	0.321						0.000			0.300		
Peds Bikes	0	0		0						0	0	
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	138		65				42	436		371	179	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	184		87				46	474		408	175	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		271						520			583	
Prop LTs		0.679						0.088			0.000	
Prop RTs	0.321						0.000			0.300		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.957						1.000			0.959		
fLT	0.967						0.920			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1726						1717			2046		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	271	1726	# 0.16	0.33	575	0.47
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	520	1717	# 0.30	0.50	859	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	583	2046	0.28	0.50	1023	0.57
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.46

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.55

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.47	0.33	15.8	1.000	575	0.50	2.6	0.0	18.4	B	18.4	B
Westbound												
Northbound												
LT	0.61	0.50	10.8	1.000	859	0.50	2.7	0.0	13.4	B	13.4	B
Southbound												
TR	0.57	0.50	10.5	1.000	1023	0.50	2.1	0.0	12.6	B	12.6	B

Intersection delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		46	
Proportion of LT in LT lane group, PLT	0.679	0.088	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		583	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.77	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.72	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		8.40	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.51	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.09	
EL1 (refer to Exhibit C16-3)		2.50	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.920	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			8.40	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.280	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		583	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.679		0.088	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.321	0.300
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	15.8	0.00	0.0	0.0	18.4
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	10.8	0.00	0.0	0.0	13.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	10.5	0.00	0.0	0.0	12.6
	0.0						0.0	
Intersection Delay			14.1	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	271						520			583		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1726						1717			2046		
LnCapacity	575						859			1023		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.47						0.61			0.57		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.6						6.2			6.8		
kB	0.5						0.7			0.8		
Q2	0.5						1.0			1.0		
Q Average	4.1						7.2			7.8		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.0						8.8			9.6		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	6.2						10.6			11.4		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.0						11.7			12.6		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.8		
BOQ	8.3						13.2			14.2		
QSRatio												
98th Percentile Output:												
fB%	2.4						2.1			2.0		
BOQ	9.6						14.8			15.8		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		119	285	596	168	79	218		404		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.12	0.13	23.7	C	39.0	D
R	220	1652	0.76	0.13	41.5	D		
Westbound								
LTR	1338	4723	0.90	0.28	26.0	C	26.0	C
Northbound								
L	148	443	0.58	0.33	30.9	C		
T	621	1863	0.38	0.33	16.9	B	20.6	C
Southbound								
TR	707	2120	0.66	0.33	20.7	C	20.7	C

Intersection Delay = 25.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		119	285	596	168	79	218		404	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		42	82	171	48	21	59		112	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		168		1206		86	237			468	
%InSharedLn												
Prop LTs					0.272		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000		0.041		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		119	285	596	168	79	218		404	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		168	328	685	193	86	237		449	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	27		168		1206		86	237			468	
Prop LTs					0.272		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000			0.041	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.980	0.980	0.990	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.976	0.976		1.000	0.995	0.995
fLT	0.950		0.987	0.987	0.238	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4723	4723	443	1863	2120	2120
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.13	222	0.12
Prot							
Perm							
Thru							
Right	R	168	1652	# 0.10	0.13	220	0.76
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1206	4723	# 0.26	0.28	1338	0.90
Right							
Northbound							
Prot							
Perm							
Left	L	86	443	0.19	0.33	148	0.58
Prot							
Perm							
Thru	T	237	1863	0.13	0.33	621	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	468	2120	# 0.22	0.33	707	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.12	0.13	22.9	1.000	222	0.50	0.8	0.0	23.7	C	39.0	D	
R	0.76	0.13	25.1	1.000	220	0.50	16.4	0.0	41.5	D			
Westbound													
LTR	0.90	0.28	20.7	1.000	1338	0.50	5.3	0.0	26.0	C	26.0	C	
Northbound													
L	0.58	0.33	16.5	1.000	148	0.50	14.4	0.0	30.9	C	20.6	C	
T	0.38	0.33	15.3	1.000	621	0.50	1.6	0.0	16.9	B			
Southbound													
TR	0.66	0.33	17.1	1.000	707	0.50	3.6	0.0	20.7	C	20.7	C	

Intersection delay = 25.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			86	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			468	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.43	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.80	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			10.38	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.62	
n=Max(gq-gf)/2,0)			5.19	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.02	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.238	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.272 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.38	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.519	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			468	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.160	0.041
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.7
	0.0						0.0	
R	0.0	0.00	26.0	25.1	0.00	0.0	0.0	41.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.7	0.00	0.0	0.0	26.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.5	0.00	0.0	0.0	30.9
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	17.1	0.00	0.0	0.0	20.7
	0.0						0.0	

Intersection Delay	25.2	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	27	168		442		86	237		468
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1733		443	1863		2120
LnCapacity	222	220		491		148	621		707
Flow Ratio	0.0	0.1		0.3		0.2	0.1		0.2
v/c Ratio	0.12	0.76		0.90		0.58	0.38		0.66
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.717		0.483			0.917		0.747
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.4	2.7		7.1		1.2	3.0		6.7
kB	0.2	0.2		0.3		0.2	0.6		0.5
Q2	0.0	0.6		1.8		0.3	0.3		1.0
Q Average	0.4	3.3		8.9		1.5	3.4		7.6
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.6	4.2		10.8		1.9	4.2		9.3
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.5
BOQ	0.7	5.2		12.8		2.4	5.2		11.2
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.8	5.9		14.0		2.7	5.9		12.3
QSRatio									
95th Percentile Output:									
fB%	2.5	2.1		1.8		2.3	2.1		1.8
BOQ	1.1	7.0		15.7		3.4	7.1		13.9
QSRatio									
98th Percentile Output:									
fB%	3.1	2.5		2.0		2.8	2.5		2.0
BOQ	1.3	8.2		17.3		4.1	8.3		15.5
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	30	32	5				3	267	143	305	457	46
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.19 0.28 17.2 B 17.2 B

Westbound

Northbound

LTR 966 1757 0.46 0.55 9.6 A 9.6 A

Southbound

L 508 924 0.67 0.55 14.0 B
 TR 1024 1861 0.53 0.55 9.9 A 11.5 B

Intersection Delay = 11.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	32	5				3	267	143	305	457	46
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	11	2				1	73	39	85	127	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		88						448		339	547	
%InSharedLn												
Prop LTs		0.443						0.007		1.000	0.000	
Prop RTs	0.080						0.346			0.071		
Peds Bikes	0	0		0			0	0		0	0	
Buses	0						0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	30	32	5				3	267	143	305	457	46
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	39	42	7				3	290	155	339	508	39
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L TR		
Adj flow	88						448			339 547		
Prop LTs	0.443						0.007			1.000 0.000		
Prop RTs	0.080						0.346			0.071		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L TR		
So	1900						1900			1900 1900		
Lanes 0	1	0	0	0	0	0	1	0		1	1	0
fW	1.033						1.133			1.000 1.000		
fHV	0.980						0.980			0.990 0.990		
fG	1.000						1.000			1.000 1.000		
fP	0.875						0.875			1.000 1.000		
fBB	1.000						1.000			1.000 1.000		
fA	1.000						1.000			1.000 1.000		
fLU	1.000						1.000			1.000 1.000		
fRT	0.989						0.953			0.989		
fLT	0.978						0.998			0.491 1.000		
Sec.												
fLpb	1.000						1.000			1.000 1.000		
fRpb	1.000						1.000			1.000		
S	1630						1757			924 1861		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1630	# 0.05	0.28	462	0.19
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	448	1757	0.25	0.55	966	0.46
Right							
Southbound							
Prot							
Perm							
Left	L	339	924	# 0.37	0.55	508	0.67
Prot							
Perm							
Thru	TR	547	1861	0.29	0.55	1024	0.53
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.19	0.28	16.3	1.000	462	0.50	0.9	0.0	17.2	B	17.2	B
Westbound												
Northbound												
LTR	0.46	0.55	8.2	1.000	966	0.50	1.4	0.0	9.6	A	9.6	A
Southbound												
L	0.67	0.55	9.6	1.000	508	0.50	4.4	0.0	14.0	B		
TR	0.53	0.55	8.6	1.000	1024	0.50	1.3	0.0	9.9	A	11.5	B

Intersection delay = 11.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				339
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				448
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.65
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.47
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.80
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.20
n=Max(gq-gf)/2,0)				2.40
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.99
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.39
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				4.80
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.491

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.443
Proportion of LT in opposing flow, PLTo	0.007 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	547
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.12
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	6.41
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.41	4.80
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.194	0.146
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			547	448
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.007	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.080	0.346	0.071
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.2	0.00	0.0	0.0	9.6
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.6	0.00	0.0	0.0	14.0
TR	0.0	0.00	13.5	8.6	0.00	0.0	0.0	9.9
	0.0						0.0	

Intersection Delay	11.2	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		88						448			339	547
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1630						1757			924	1861
LnCapacity		462						966			508	1024
Flow Ratio		0.1						0.3			0.4	0.3
v/c Ratio		0.19						0.46			0.67	0.53
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.899				0.644
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		1.1						4.5			4.0	5.8
kB		0.5						0.8			0.3	0.6
Q2		0.1						0.6			0.7	0.6
Q Average		1.2						5.2			4.7	6.4
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.6						6.4			5.8	7.9
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		2.0						7.8			7.1	9.6
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		2.3						8.7			7.9	10.6
QSRatio												
95th Percentile Output:												
fB%		2.4						2.0			2.0	1.9
BOQ		2.9						10.1			9.3	12.1
QSRatio												
98th Percentile Output:												
fB%		2.9						2.2			2.3	2.1
BOQ		3.5						11.5			10.7	13.6
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	7	18	284	18	102	12	262	234	83	365	7
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	628	1414	0.06	0.44	14.4	B	14.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	580	1306	0.54	0.44	21.6	C		
T	808	1818	0.02	0.44	14.1	B	19.8	B
R	601	1352	0.19	0.44	15.8	B		

Northbound

LTR	735	1654	0.75	0.44	24.5	C	24.5	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	635	1429	0.80	0.44	26.8	C	26.8	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 23.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	7	18	284	18	102	12	262	234	83	365	7
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	79	5	28	3	71	64	23	101	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		37		316	20	113		552			506	
%InSharedLn												
Prop LTs		0.216		1.000	0.000			0.024			0.182	
Prop RTs		0.568			0.000	1.000		0.460			0.016	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	7	18	284	18	102	12	262	234	83	365	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	8	8	21	316	20	113	13	285	254	92	406	8
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	37			316	20	113	552			506		
Prop LTs	0.216			1.000	0.000		0.024			0.182		
Prop RTs	0.568			0.000 1.000			0.460			0.016		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.980			0.990	0.990	0.990	1.000			0.990		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	1.000			1.000	1.000	1.000	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.923				1.000	0.850	0.938			0.998		
fLT	0.970			0.733	1.000		0.986			0.764		
Sec.												
fLpb	1.000			0.947	1.000		1.000			0.996		
fRpb	0.968				1.000	1.000	0.974			1.000		
S	1414			1306	1818	1352	1654			1429		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	37	1414	0.03	0.44	628	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	316	1306	# 0.24	0.44	580	0.54
Prot							
Perm							
Thru	T	20	1818	0.01	0.44	808	0.02
Right	R	113	1352	0.08	0.44	601	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	552	1654	0.33	0.44	735	0.75
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	506	1429	# 0.35	0.44	635	0.80
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	628	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.54	0.44	18.3	1.000	580	0.50	3.2	0.0	21.6	C		
T	0.02	0.44	14.0	1.000	808	0.50	0.1	0.0	14.1	B	19.8	B
R	0.19	0.44	15.2	1.000	601	0.50	0.6	0.0	15.8	B		
Northbound												
LTR	0.75	0.44	20.8	1.000	735	0.50	3.7	0.0	24.5	C	24.5	C
Southbound												
LTR	0.80	0.44	21.5	1.000	635	0.50	5.3	0.0	26.8	C	26.8	C

Intersection delay = 23.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		316		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.22		
Adjusted opposing flow rate, Vo (veh/h)		37		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.90		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.78		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.733		

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	8	13	92
Proportion of LT in LT lane group, PLT	0.216	0.000	0.024
Proportion of LT in opposing flow, PLTo	0.00	0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	506	552
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.20	0.33	2.30
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	12.65	13.80
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	25.3	21.2	4.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	13.32	14.58
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.71	18.83	25.42
n=Max(gq-gf)/2,0)	0.00	0.00	5.11
PTHo=1-PLTo	1.00	0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.22	0.02	0.18
EL1 (refer to Exhibit C16-3)	1.40	2.31	2.42
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.87
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.21
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.99	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.970	0.986	0.764

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	13.32	14.58
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.333	0.364
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	20	37	506	552
OCCr	0.000	0.053	0.000	0.021
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.979
Proportion of left turns, PLT	0.216	1.000	0.024	0.182
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.568	1.000	0.460	0.016
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.968	1.000	0.974	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.4
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.3	0.00	0.0	0.0	21.6
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.8	0.00	0.0	0.0	24.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.5	0.00	0.0	0.0	26.8
	0.0						0.0	
Intersection Delay			23.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		37	316	20	113		552		506
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1414	1306	1818	1352		1654		1429
LnCapacity		628	580	808	601		735		635
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.06	0.54	0.02	0.19		0.75		0.80
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.887			0.516		0.500
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.5	5.8	0.3	1.7		11.5		10.9
kB		0.8	0.7	0.9	0.7		0.5		0.4
Q2		0.1	0.8	0.0	0.2		1.4		1.5
Q Average		0.6	6.6	0.3	1.9		12.9		12.4
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.7	8.1	0.4	2.4		15.5		15.0
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.0	9.8	0.5	3.0		18.3		17.6
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.1	10.8	0.6	3.5		19.8		19.1
QSRatio									
95th Percentile Output:									
fB%		2.5	1.9	2.5	2.3		1.7		1.7
BOQ		1.4	12.3	0.8	4.3		21.6		20.8
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.8		1.8
BOQ		1.8	13.9	0.9	5.1		23.3		22.6
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	157	232		100	151		147		78			
Lane Width	16.0			16.0			11.0					
RTOR Vol		56						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	973	1945	0.44	0.50	15.7	B	15.7	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	649	1298	0.43	0.50	16.5	B	16.5	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	571	1469	0.46	0.39	23.1	C	23.1	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 18.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		157	232	100	151		147		78			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		50	74	28	42		43		23			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		427			282			265				
%InSharedLn												
Prop LTs		0.000			0.397			0.653				
Prop RTs		0.529			0.000			0.347				
Peds Bikes	0						0			0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	157	232		100	151		147		78			
PHF	0.78	0.78		0.89	0.89		0.85		0.85			
Adj flow	201	226		112	170		173		92			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group	TR			LT			LR					
Adj flow	427			282			265					
Prop LTs	0.000			0.397			0.653					
Prop RTs	0.529			0.000			0.347					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.929			1.000			0.953					
fLT	1.000			0.627			0.968					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1945			1298			1469					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.44	0.50	14.4	1.000	973	0.50	1.3	0.0	15.7	B	15.7	B
Westbound												
LT	0.43	0.50	14.4	1.000	649	0.50	2.1	0.0	16.5	B	16.5	B
Northbound												
LR	0.46	0.39	20.5	1.000	571	0.50	2.6	0.0	23.1	C	23.1	C
Southbound												

Intersection delay = 18.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	112		
Proportion of LT in LT lane group, PLT	0.000	0.397	0.653
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	427		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	2.80		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.7		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	9.40		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.60		
n=Max(gq-gf)/2,0)	2.85		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.40		
EL1 (refer to Exhibit C16-3)	2.14		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.63		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.627		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.4	0.00	0.0	0.0	15.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	14.4	0.00	0.0	0.0	16.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	20.5	0.00	0.0	0.0	23.1
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			18.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		427			282			265				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1945			1298			1469				
LnCapacity		973			649			571				
Flow Ratio		0.2			0.2			0.2				
v/c Ratio		0.44			0.43			0.46				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		6.8			4.5			4.9				
kB		1.0			0.8			0.7				
Q2		0.8			0.6			0.6				
Q Average		7.6			5.1			5.6				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		9.3			6.3			6.9				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		11.2			7.7			8.3				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.7			1.7				
BOQ		12.3			8.6			9.3				
QSRatio												
95th Percentile Output:												
fB%		1.8			2.0			1.9				
BOQ		13.9			10.1			10.7				
QSRatio												
98th Percentile Output:												
fB%		2.0			2.2			2.2				
BOQ		15.5			11.5			12.2				
QSRatio												

ERROR MESSAGES

No errors to report.

No-Action

2020

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	9	8	8	62	10	28	27	152	42	29	157	39
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB Left	P		
	Thru		P			Thru	P		
	Right		P			Right	P		
	Peds		X			Peds	X		
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 179 1533 0.17 0.12 26.0 C 26.0 C

Westbound

LTR 479 1915 0.22 0.25 18.9 B 18.9 B

Northbound

LTR 619 1614 0.43 0.38 15.9 B 15.9 B

Southbound

LTR 657 1713 0.41 0.38 15.5 B 15.5 B

Intersection Delay = 16.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	8	8	62	10	28	27	152	42	29	157	39
% Heavy Veh	32	32	32	5	5	5	20	20	20	13	13	13
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	3	3	3	16	3	7	8	46	13	9	47	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		31			105			267			271	
%InSharedLn												
Prop LTs		0.355			0.619			0.124			0.129	
Prop RTs		0.323			0.276			0.191			0.173	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			4			4	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	8	8	62	10	28	27	152	42	29	157	39
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	11	10	10	65	11	29	33	183	51	35	189	47
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	31			105			267			271		
Prop LTs	0.355			0.619			0.124			0.129		
Prop RTs	0.323			0.276			0.191			0.173		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.758			0.952			0.833			0.885		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.984			0.984		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.956			0.963			0.974			0.977		
fLT	0.983			0.970			0.939			0.935		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1533			1915			1614			1713		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	31	1533	# 0.02	0.12	179	0.17
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	105	1915	# 0.05	0.25	479	0.22
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	267	1614	# 0.17	0.38	619	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	271	1713	0.16	0.38	657	0.41
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.24
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.32

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.17	0.12	23.9	1.000	179	0.50	2.1	0.0	26.0	C	26.0	C
Westbound												
LTR	0.22	0.25	17.9	1.000	479	0.50	1.1	0.0	18.9	B	18.9	B
Northbound												
LTR	0.43	0.38	13.7	1.000	619	0.50	2.2	0.0	15.9	B	15.9	B
Southbound												
LTR	0.41	0.38	13.6	1.000	657	0.50	1.9	0.0	15.5	B	15.5	B

Intersection delay = 16.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	35
Proportion of LT in LT lane group, PLT	0.355	0.619	0.124	0.129
Proportion of LT in opposing flow, PLTo			0.13	0.12
Adjusted opposing flow rate, Vo (veh/h)			271	267
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.52	4.45
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			4.34	4.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.26	15.54
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.87	0.88
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.12	0.13
EL1 (refer to Exhibit C16-3)			1.83	1.82
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.939	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				4.23
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.184
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				267
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.129
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.323	0.191
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	23.9	0.00	0.0	0.0	26.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.9	0.00	0.0	0.0	18.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.7	0.00	0.0	0.0	15.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.6	0.00	0.0	0.0	15.5
	0.0						0.0	
Intersection Delay			16.6	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	31		105		267		271	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	1 0	0 0	1 0	0 0	1 0	0 0
SL	1533		1915		1614		1713	
LnCapacity	179		479		619		657	
Flow Ratio	0.0		0.1		0.2		0.2	
v/c Ratio	0.17		0.22		0.43		0.41	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	0.5		1.4		3.3		3.3	
kB	0.3		0.5		0.6		0.6	
Q2	0.1		0.1		0.5		0.4	
Q Average	0.5		1.5		3.7		3.8	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	0.7		2.0		4.7		4.7	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.6		1.5		1.5	
BOQ	0.9		2.5		5.8		5.8	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.9		1.7		1.7	
BOQ	1.0		2.9		6.5		6.5	
QSRatio								
95th Percentile Output:								
fB%	2.5		2.3		2.1		2.1	
BOQ	1.3		3.6		7.8		7.8	
QSRatio								
98th Percentile Output:								
fB%	3.1		2.8		2.4		2.4	
BOQ	1.6		4.3		9.0		9.0	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6-19-13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		205	32			20	206	
Peak-Hour Factor, PHF		0.83	0.83			0.83	0.83	
Hourly Flow Rate, HFR		246	38			24	248	
Percent Heavy Vehicles		--	--			11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		8		16				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		11		23				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound				
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		24			34					
C(m) (vph)		1228			650					
v/c		0.02			0.05					
95% queue length		0.06			0.17					
Control Delay		8.0			10.8					
LOS		A			B					
Approach Delay					10.8					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6-19-13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		205	32	20	206	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		62	10	6	62	
Hourly Flow Rate, HFR		246	38	24	248	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	8		16			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	11		23			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		248
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		284	561		265			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	265	
Potential Capacity	779	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	779	
Probability of Queue free St.	0.97	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	284	
Potential Capacity	1228	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1228	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	561	
Potential Capacity	492	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.95
Movement Capacity	482	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 561
Potential Capacity 492
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.95
Movement Capacity 482

Results for Two-stage process:
a
y
C t 482

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	11		23			
Movement Capacity (vph)	482		779			
Shared Lane Capacity (vph)		650				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	482		779			
Volume	11		23			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		650				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		24		34				
C(m) (vph)		1228		650				
v/c		0.02		0.05				
95% queue length		0.06		0.17				
Control Delay		8.0		10.8				
LOS		A		B				
Approach Delay				10.8				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		248
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6-19-13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	277	34	272	0	146	306	89	116	9
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 708 1700 0.02 0.42 10.3 B 10.3 B

Westbound

LT 530 1273 0.67 0.42 20.5 C 19.6 B
 R 514 1233 0.61 0.42 18.7 B

Northbound

LTR 702 1684 0.76 0.42 21.6 C 21.6 C

Southbound

LTR 389 934 0.63 0.42 21.4 C 21.4 C

Intersection Delay = 20.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6-19-13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	277	34	272	0	146	306	89	116	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	80	10	78	0	43	90	26	33	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			357	313		532			245	
%InSharedLn												
Prop LTs		0.273			0.891			0.000			0.416	
Prop RTs		0.091			0.000	1.000		0.677			0.041	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	277	34	272	0	146	306	89	116	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	318	39	313	0	172	360	102	133	10
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			357 313			532			245		
Prop LTs	0.273			0.891			0.000			0.416		
Prop RTs	0.091			0.000 1.000			0.677			0.041		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.909			0.994		
fLT	0.937			0.741			1.000			0.490		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1700			1273 1233			1684			934		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1700	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	357	1273	# 0.28	0.42	530	0.67
Right	R	313	1233	0.25	0.42	514	0.61
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	532	1684	# 0.32	0.42	702	0.76
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	245	934	0.26	0.42	389	0.63
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.67	0.42	14.2	1.000	530	0.50	6.3	0.0	20.5	C	19.6	B
R	0.61	0.42	13.7	1.000	514	0.50	5.0	0.0	18.7	B		
Northbound												
LTR	0.76	0.42	14.9	1.000	702	0.50	6.7	0.0	21.6	C	21.6	C
Southbound												
LTR	0.63	0.42	13.8	1.000	389	0.50	7.5	0.0	21.4	C	21.4	C

Intersection delay = 20.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
----------------------------------	-------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	318	0	102
Proportion of LT in LT lane group, PLT	0.273	0.891	0.000	0.416
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	357	11	245	532
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.30	0.00	1.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.95	0.18	4.08	8.87
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	2.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.86	0.00	3.15	9.72
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	21.85	15.28
n=Max(gq-gf)/2,0)	0.00	0.00	1.58	3.60
PTHo=1-PLTo	0.11	0.73	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.42
EL1 (refer to Exhibit C16-3)	1.99	1.39	1.78	2.37
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.37	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	3.15	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.937	0.741	1.000	0.490

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.86			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.234			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	357			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	25.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.2	0.00	0.0	0.0	20.5
R	0.0	0.00	17.5	13.7	0.00	0.0	0.0	18.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.9	0.00	0.0	0.0	21.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.8	0.00	0.0	0.0	21.4
	0.0						0.0	
Intersection Delay			20.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		LTR		
Init Queue	0.0			0.0	0.0	0.0		0.0		
Flow Rate	11			357	313	532		245		
So	1900			1900	1900	1900		1900		
No.Lanes	0	1	0	0	1	1	0	1	0	0
SL	1700			1273	1233	1684		934		
LnCapacity	708			530	514	702		389		
Flow Ratio	0.0			0.3	0.3	0.3		0.3		
v/c Ratio	0.02			0.67	0.61	0.76		0.63		
Grn Ratio	0.42			0.42	0.42	0.42		0.42		
I Factor	1.000			0.940		0.887		1.000		
AT or PVG	3			3	3	3		3		
Pltn Ratio	1.00			1.00	1.00	1.00		1.00		
PF2	1.00			1.00	1.00	1.00		1.00		
Q1	0.1			4.8	4.1	7.6		3.2		
kB	0.7			0.5	0.5	0.6		0.4		
Q2	0.0			1.0	0.8	1.7		0.7		
Q Average	0.1			5.8	4.8	9.3		4.0		
Q Spacing	25.0			25.0	25.0	25.0		25.0		
Q Storage	0			0	0	0		0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2		
BOQ	0.2			7.2	6.0	11.3		4.9		
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.5	1.4		1.5		
BOQ	0.2			8.7	7.3	13.4		6.1		
QSRatio										
90th Percentile Output:										
fB%	2.0			1.7	1.7	1.6		1.7		
BOQ	0.2			9.7	8.2	14.6		6.8		
QSRatio										
95th Percentile Output:										
fB%	2.6			1.9	2.0	1.8		2.1		
BOQ	0.3			11.2	9.6	16.3		8.1		
QSRatio										
98th Percentile Output:										
fB%	3.2			2.2	2.3	1.9		2.4		
BOQ	0.4			12.7	11.0	18.0		9.4		
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6-19-13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				160		5		447			393	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 631 1894 0.30 0.33 15.9 B 15.9 B

Northbound

T 970 1940 0.54 0.50 12.2 B 12.2 B

Southbound

T 925 1850 0.49 0.50 11.3 B 11.3 B

Intersection Delay = 12.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6-19-13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				160		5	447			393		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				45		2	131			113		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					188		526			452		
%InSharedLn												
Prop LTs					0.968		0.000			0.000		
Prop RTs					0.032		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				160		5	447			393		
PHF				0.88		0.88	0.85			0.87		
Adj flow				182		6	526			452		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					188			526			452	
Prop LTs					0.968			0.000			0.000	
Prop RTs					0.032			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.996			1.000			1.000	
fLT					0.954			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1894			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	188	1894	# 0.10	0.33	631	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	526	1940	# 0.27	0.50	970	0.54
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	452	1850	0.24	0.50	925	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.30	0.33	14.8	1.000	631	0.50	1.1	0.0	15.9	B	15.9	B
Northbound												
T	0.54	0.50	10.3	1.000	970	0.50	1.9	0.0	12.2	B	12.2	B
Southbound												
T	0.49	0.50	9.9	1.000	925	0.50	1.4	0.0	11.3	B	11.3	B

Intersection delay = 12.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.968 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
--	------	------	------	------

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	15.9
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.3	0.00	0.0	0.0	12.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.9	0.00	0.0	0.0	11.3
	0.0						0.0	
Intersection Delay			12.5	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 3/28/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		447	223	119	434	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		131	66	34	125	
Hourly Flow Rate, HFR		525	262	136	498	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		498
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		787						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	787	
Potential Capacity	758	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	758	
Probability of Queue free St.	0.82	1.00
Maj L-Shared Prob Q free St.	0.75	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.75	0.75
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		136						
C(m) (vph)		758						
v/c		0.18						
95% queue length		0.65						
Control Delay		10.8						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.82
v(il), Volume for stream 2 or 5		498
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.75
d(M,LT), Delay for stream 1 or 4		10.8
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.7

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/12
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				62		155	512	74		99	329	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR	383	1438	0.61	0.27	26.2	C	26.2	C
----	-----	------	------	------	------	---	------	---

Northbound

TR	1032	1821	0.67	0.57	11.7	B	11.7	B
----	------	------	------	------	------	---	------	---

Southbound

LT	719	1269	0.68	0.57	13.6	B	13.6	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 14.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/12
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				62		155	512	74		99	329	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				17		42	151	22		28	95	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					234			689			492	
%InSharedLn												
Prop LTs					0.286			0.000			0.232	
Prop RTs					0.714			0.126			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				62		155	512	74		99	329	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				67		167	602	87		114	378	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					234			689			492	
Prop LTs					0.286			0.000			0.232	
Prop RTs					0.714			0.126			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.901			0.917	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.904			0.983			1.000	
fLT					0.986			1.000			0.670	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1438			1821			1269	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	234	1438	# 0.16	0.27	383	0.61
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	689	1821	0.38	0.57	1032	0.67
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	492	1269	# 0.39	0.57	719	0.68
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.61	0.27	19.3	1.000	383	0.50	7.0	0.0	26.2	C	26.2	C
Northbound												
TR	0.67	0.57	9.1	1.000	1032	0.50	2.6	0.0	11.7	B	11.7	B
Southbound												
LT	0.68	0.57	9.2	1.000	719	0.50	4.4	0.0	13.6	B	13.6	B

Intersection delay = 14.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			114
Proportion of LT in LT lane group, PLT	0.286	0.000	0.232
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			689
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.90
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.48
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			4.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.07
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.93
n=Max(gq-gf)/2,0)			1.85
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.23
EL1 (refer to Exhibit C16-3)			2.77
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.67
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.670

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.07
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.237
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				689
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.232
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.714	0.126
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.3	0.00	0.0	0.0	26.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.1	0.00	0.0	0.0	11.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	9.2	0.00	0.0	0.0	13.6
	0.0						0.0	
Intersection Delay			14.8	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	71	27	73	23	133	50	68	657	112	67	358	29
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	551	1601	0.34	0.34	23.3	C	23.3	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	577	1675	0.38	0.34	24.1	C	24.1	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	403	741	0.18	0.54	11.0	B		
TR	1048	1925	0.80	0.54	20.7	C	19.9	B

Southbound

LTR	963	1769	0.55	0.54	15.6	B	15.6	B
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 19.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	27	73	23	133	50	68	657	112	67	358	29
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	20	8	20	6	35	13	18	179	30	20	107	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		190			218		74	836			533	
%InSharedLn												
Prop LTs		0.416			0.110		1.000	0.000			0.150	
Prop RTs		0.426			0.243			0.146			0.051	
Peds Bikes	0	0		0	0		0	0	0	0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	27	73	23	133	50	68	657	112	67	358	29
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	79	30	81	24	141	53	74	714	122	80	426	27
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	190			218			74 836			533		
Prop LTs	0.416			0.110			1.000 0.000			0.150		
Prop RTs	0.426			0.243			0.146			0.051		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.942			0.967			0.978			0.992		
fLT	0.797			0.956			0.431 1.000			0.603		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1601			1675			741 1925			1769		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	190	1601	0.12	0.34	551	0.34
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	218	1675	# 0.13	0.34	577	0.38
Right							
Northbound							
Prot							
Perm							
Left	L	74	741	0.10	0.54	403	0.18
Prot							
Perm							
Thru	TR	836	1925	# 0.43	0.54	1048	0.80
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	533	1769	0.30	0.54	963	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.34	0.34	21.9	1.000	551	0.50	1.4	0.0	23.3	C	23.3	C
Westbound												
LTR	0.38	0.34	22.2	1.000	577	0.50	1.9	0.0	24.1	C	24.1	C
Northbound												
L	0.18	0.54	10.4	1.000	403	0.50	0.7	0.0	11.0	B		
TR	0.80	0.54	16.5	1.000	1048	0.50	4.2	0.0	20.7	C	19.9	B
Southbound												
LTR	0.55	0.54	13.4	1.000	963	0.50	2.3	0.0	15.6	B	15.6	B

Intersection delay = 19.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			74	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.15	
Adjusted opposing flow rate, Vo (veh/h)			533	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.85	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.00	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			2.55	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			46.45	
n=Max(gq-gf)/2,0)			1.28	
PTHo=1-PLTo			0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.20	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.25	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			2.55	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.43	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.431	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	79	24	80
Proportion of LT in LT lane group, PLT	0.416	0.110	0.000
Proportion of LT in opposing flow, PLTo	0.11	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	218	190	836
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.98	0.60	2.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.45	4.75	20.90
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.3	11.6	6.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	6.50	5.35	30.56
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.50	19.38	18.44
n=Max(gq-gf)/2,0)	1.61	0.00	12.03
PTHo=1-PLTo	0.89	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.11	0.60
EL1 (refer to Exhibit C16-3)	1.73	1.68	3.19
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.55	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.07
gdif=max(gq-gf,0)	3.21	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.80	0.96	0.30
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.797	0.956	0.603

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	6.50	5.35	2.55	30.56
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.210	0.173	0.052	0.624
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	218	190	533	836
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.416	0.110	1.000	0.150
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.426	0.243	0.146	0.051
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.9	0.00	0.0	0.0	23.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.2	0.00	0.0	0.0	24.1
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.4	0.00	0.0	0.0	11.0
TR	0.0	0.00	20.5	16.5	0.00	0.0	0.0	20.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	13.4	0.00	0.0	0.0	15.6
	0.0						0.0	
Intersection Delay			19.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	190		218		74	836	279	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	1 0	0	1 1 0	0	2 0	
SL	1601		1675		741	1925	929	
LnCapacity	551		577		403	1048	505	
Flow Ratio	0.1		0.1		0.1	0.4	0.3	
v/c Ratio	0.34		0.38		0.18	0.80	0.55	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	3.5		4.1		0.9	16.8	4.5	
kB	0.6		0.8		0.4	0.8	0.7	
Q2	0.3		0.5		0.1	2.7	0.8	
Q Average	3.9		4.6		1.0	19.6	5.4	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	4.8		5.7		1.3	23.5	6.6	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	5.9		7.0		1.7	27.5	8.1	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.7	
BOQ	6.7		7.8		2.0	29.5	9.0	
QSRatio								
95th Percentile Output:								
fB%	2.1		2.0		2.4	1.6	1.9	
BOQ	7.9		9.2		2.5	31.7	10.4	
QSRatio								
98th Percentile Output:								
fB%	2.4		2.3		2.9	1.7	2.2	
BOQ	9.2		10.5		3.0	33.9	11.9	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	283						778			394		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.47	0.33	26.1	C	26.1	C

Westbound

Northbound

T 2156 3880 0.40 0.56 11.8 B 11.8 B

Southbound

T 1951 3512 0.24 0.56 10.5 B 10.5 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	283						778			394		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	79						214			117		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	314						855			469		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	283						778			394		
PHF	0.90						0.91			0.84		
Adj flow	314						855			469		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	314						855			469		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.990				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3880				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	314	2006	# 0.16	0.33	669	0.47
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	855	3880	# 0.22	0.56	2156	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	469	3512	0.13	0.56	1951	0.24
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.38$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.42$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.47	0.33	23.7	1.000	669	0.50	2.4	0.0	26.1	C	26.1	C	
Westbound													
Northbound													
T	0.40	0.56	11.4	1.000	2156	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.24	0.56	10.3	1.000	1951	0.50	0.3	0.0	10.5	B	10.5	B	

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.7	0.00	0.0	0.0	26.1
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.4	0.00	0.0	0.0	11.8
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.3	0.00	0.0	0.0	10.5
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	314						449		246	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.2						0.2		0.1	
v/c Ratio	0.47						0.40		0.24	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.2						6.4		3.2	
kB	0.9						0.8		1.1	
Q2	0.7						0.5		0.4	
Q Average	7.0						6.9		3.5	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	8.5						8.5		4.4	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.3						10.2		5.4	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	11.3						11.3		6.1	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		2.1	
BOQ	12.9						12.8		7.4	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.4	
BOQ	14.4						14.4		8.6	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					394	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					117	
Hourly Flow Rate, HFR					469	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						59
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						21
Hourly Flow Rate, HFR						84
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								234
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		234
Potential Capacity		681
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		681
Probability of Queue free St.	1.00	0.88

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	564
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	564
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	564	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	564	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	634
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	634

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	810	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity	710	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						84
Movement Capacity (vph)						681
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						681
Volume						84
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								84
C(m) (vph)								681
v/c								0.12
95% queue length								0.42
Control Delay								11.0
LOS								B
Approach Delay							11.0	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	49	160	164	203	484	78	87	197	74	67	26	27
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	173	520	0.32	0.33	26.3	C		
TR	580	1740	0.56	0.33	27.6	C	27.4	C
Westbound								
L	224	672	1.04	0.33	100.4	F		
TR	1094	3283	0.59	0.33	27.1	C	46.6	D
Northbound								
LTR	906	3260	0.43	0.28	28.1	C	28.1	C
Southbound								
L	376	1694	0.27	0.22	30.6	C		
TR	354	1591	0.22	0.22	30.1	C	30.4	C

Intersection Delay = 37.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	49	160	164	203	484	78	87	197	74	67	26	27
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	14	45	47	58	139	22	23	53	20	25	10	10
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	56	325		233	641			386		100	79	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.244			0.000	
Prop RTs		0.440			0.133			0.207			0.506	
Peds Bikes		0			0	0		0			0	
Buses	0	0		0	0			0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Arriv. Type	3	3		3	3			3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
I Factor		0.780			0.979			1.000			0.991	
Lost Time	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	49	160	164	203	484	78	87	197	74	67	26	27
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	56	182	143	233	556	85	94	212	80	100	39	40
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	56	325		233	641			386		100	79	
Prop LTs	1.000	0.000		1.000	0.000			0.244			0.000	
Prop RTs		0.440			0.133			0.207			0.506	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.980	0.980		0.926	0.926			0.926		0.971	0.971	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.934			0.980			0.969			0.924	
fLT	0.289	1.000		0.409	1.000			0.988		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	520	1740		672	3283			3260		1694	1591	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	--Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	56	520	0.11	0.33	173	0.32
Prot							
Perm							
Thru	TR	325	1740	0.19	0.33	580	0.56
Right							
Westbound							
Prot							
Perm							
Left	L	233	672	# 0.35	0.33	224	1.04
Prot							
Perm							
Thru	TR	641	3283	0.20	0.33	1094	0.59
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	386	3260	# 0.12	0.28	906	0.43
Right							
Southbound							
Prot							
Perm							
Left	L	100	1694	# 0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	79	1591	0.05	0.22	354	0.22
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.32	0.33	22.4	1.000	173	0.50	3.8	0.0	26.3	C			
TR	0.56	0.33	24.6	1.000	580	0.50	3.0	0.0	27.6	C	27.4	C	
Westbound													
L	1.04	0.33	30.0	1.000	224	0.50	70.4	0.0	100.4	F			
TR	0.59	0.33	24.9	1.000	1094	0.50	2.3	0.0	27.1	C	46.6	D	
Northbound													
LTR	0.43	0.28	26.6	1.000	906	0.50	1.5	0.0	28.1	C	28.1	C	
Southbound													
L	0.27	0.22	28.9	1.000	376	0.50	1.7	0.0	30.6	C			
TR	0.22	0.22	28.6	1.000	354	0.50	1.4	0.0	30.1	C	30.4	C	

Intersection delay = 37.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	56	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	641	325		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	1.40	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.42	8.13		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	8.80	8.22		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.20	21.78		
n=Max(gq-gf)/2,0)	4.40	4.11		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.45	1.77		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.29	0.41		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.289	0.409		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.244 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	8.80			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.293			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	641			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.133
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	22.4	0.00	0.0	0.0	26.3
TR	0.0	0.00	30.0	24.6	0.00	0.0	0.0	27.6
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	2.2	0.0	100.4
TR	0.0	0.00	30.0	24.9	0.00	0.0	0.0	27.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.6	0.00	0.0	0.0	28.1
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.9	0.00	0.0	0.0	30.6
TR	0.0	0.00	35.0	28.6	0.00	0.0	0.0	30.1
	0.0						0.0	
Intersection Delay			37.1	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	56	325		233	336		202			100	79	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	520	1740		672	1724		1712			1694	1591	
LnCapacity	173	580		224	574		475			376	354	
Flow Ratio	0.1	0.2		0.3	0.2		0.1			0.1	0.0	
v/c Ratio	0.32	0.56		1.04	0.59		0.43			0.27	0.22	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.0	6.7		5.8	7.0		4.1			2.1	1.6	
kB	0.3	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.1	0.8		4.0	1.0		0.5			0.2	0.2	
Q Average	1.2	7.4		9.8	8.0		4.6			2.3	1.8	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	1.5	9.1		11.9	9.8		5.7			2.9	2.3	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.6	
BOQ	1.9	10.9		14.2	11.7		7.0			3.6	2.9	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.6		1.6	1.6		1.7			1.8	1.9	
BOQ	2.2	12.0		15.4	12.8		7.9			4.1	3.3	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.8		1.7	1.8		2.0			2.2	2.3	
BOQ	2.8	13.6		17.1	14.4		9.2			5.1	4.1	
QSRatio												
98th Percentile Output:												
fB%	2.9	2.0		1.9	2.0		2.3			2.7	2.8	
BOQ	3.4	15.1		18.8	16.0		10.6			6.0	4.9	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 394
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 104
 Hourly Flow Rate, HFR 414
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 0
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 0
 Hourly Flow Rate, HFR 0
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			414					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	414	
Potential Capacity	583	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	583	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 414
Potential Capacity 583
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 583

Results for Two-stage process:
a
y
C t 583

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	0					
Movement Capacity (vph)	583					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	583					
Volume	0					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			0					
C(m) (vph)			583					
v/c			0.00					
95% queue length			0.00					
Control Delay			11.2					
LOS			B					
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	64	18	33	75	0	11	0	21	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.80	0.80	0.78	0.78	0.86	0.86		
Flow Rate	39	61	89	48	12	24		
% Heavy Veh	21	21	1	1	5	5		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	39	61	89	48	12	24		
Left-Turn	0	0	42	0	12	0		
Right-Turn	0	22	0	0	0	24		
Prop. Left-Turns	0.0	0.0	0.5	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	54	33	202	177	406	6	262	74	51	11	98	102
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 759 2971 0.43 0.26 29.7 C 29.7 C

Westbound

LTR 883 3455 0.77 0.26 37.1 D 37.1 D

Northbound

DefL 350 1085 0.86 0.32 51.7 D
 TR 571 1772 0.25 0.32 23.6 C 42.6 D

Southbound

LTR 863 2677 0.32 0.32 24.0 C 24.0 C

Intersection Delay = 35.0- (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	54	33	202	177	406	6	262	74	51	11	98	102
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	57	51	117	2	75	21	15	4	32	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		329			677		301	144			277	
%InSharedLn												
Prop LTs		0.185			0.300		1.000	0.000			0.051	
Prop RTs		0.699			0.010			0.410			0.484	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	54	33	202	177	406	6	262	74	51	11	98	102
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	61	38	230	203	467	7	301	85	59	14	129	134
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	329			677			301 144			277		
Prop LTs	0.185			0.300			1.000 0.000			0.051		
Prop RTs	0.699			0.010			0.410			0.484		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.895			0.998			0.939			0.927		
fLT	0.991			0.985			0.575 1.000			0.940		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2971			3455			1085 1772			2677		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	329	2971	# 0.11	0.26	759	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	677	3455	# 0.20	0.26	883	0.77
Right							
Northbound							
Prot							
Perm							
Left	DefL	301	1085	# 0.28	0.32	350	0.86
Prot							
Perm							
Thru	TR	144	1772	0.08	0.32	571	0.25
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	277	2677	0.10	0.32	863	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.43	0.26	28.0	1.000	759	0.50	1.7	0.0	29.7	C	29.7	C	
Westbound													
LTR	0.77	0.26	31.0	1.000	883	0.50	6.0	0.0	37.1	D	37.1	D	
Northbound													
DefL	0.86	0.32	28.6	1.000	350	0.50	23.1	0.0	51.7	D			
TR	0.25	0.32	22.5	1.000	571	0.50	1.1	0.0	23.6	C	42.6	D	
Southbound													
LTR	0.32	0.32	23.1	1.000	863	0.50	1.0	0.0	24.0	C	24.0	C	

Intersection delay = 35.0- (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			301	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			277	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.53	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			3.64	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			0.36	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			28.64	
n=Max(gq-gf)/2,0)			0.18	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.72	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			0.36	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.57	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.575	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	14
Proportion of LT in LT lane group, PLT	0.185 0.300 0.000 0.051
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	144
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.35
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.80
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	14.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.86
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.10
EL1 (refer to Exhibit C16-3)	1.60
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.940

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				144
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.051
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.699	0.010	0.410
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	28.0	0.00	0.0	0.0 0.0 0.0	29.7
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	31.0	0.00	0.0	0.0 0.0 0.0	37.1
Northbound								
DefL	0.0	0.00	30.5	28.6	0.00	0.0	0.0	51.7
TR	0.0 0.0	0.00	30.5	22.5	0.00	0.0	0.0 0.0	23.6
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	23.1	0.00	0.0	0.0 0.0 0.0	24.0
Intersection Delay			35.0-	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR			LTR		DefL	TR			LTR	
Init Queue		0.0			0.0		0.0	0.0			0.0	
Flow Rate		172			355		301	144			145	
So		1900			1900		1900	1900			1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	2	0
SL		1560			1814		1085	1772			1405	
LnCapacity		398			463		350	571			453	
Flow Ratio		0.1			0.2		0.3	0.1			0.1	
v/c Ratio		0.43			0.77		0.86	0.25			0.32	
Grn Ratio		0.26			0.26		0.32	0.32			0.32	
I Factor		0.916			0.953			1.000			1.000	
AT or PVG		3			3		3	3			3	
Pltn Ratio		1.00			1.00		1.00	1.00			1.00	
PF2		1.00			1.00		1.00	1.00			1.00	
Q1		3.6			8.2		7.1	2.7			2.7	
kB		0.5			0.6		0.5	0.8			0.7	
Q2		0.4			1.8		2.4	0.3			0.3	
Q Average		4.0			10.1		9.5	2.9			3.0	
Q Spacing		25.0			25.0		25.0	25.0			25.0	
Q Storage		0			0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2		1.2	1.3			1.3	
BOQ		5.0			12.2		11.5	3.7			3.8	
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4		1.4	1.6			1.6	
BOQ		6.2			14.5		13.7	4.6			4.8	
QSRatio												
90th Percentile Output:												
fB%		1.7			1.6		1.6	1.8			1.8	
BOQ		6.9			15.8		14.9	5.2			5.4	
QSRatio												
95th Percentile Output:												
fB%		2.0			1.7		1.8	2.2			2.1	
BOQ		8.2			17.4		16.6	6.3			6.5	
QSRatio												
98th Percentile Output:												
fB%		2.4			1.9		1.9	2.5			2.5	
BOQ		9.5			19.1		18.2	7.4			7.7	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	798	244	19	4	275	249	4	16	6	109	5	145
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	847	1728	1.04	0.71	52.0	D		
TR	1158	1628	0.25	0.71	4.9	A	40.3	D
Westbound								
LT	449	1835	0.72	0.24	40.3	D	42.0	D
R	383	1568	0.76	0.24	43.8	D		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.55	0.18	43.2	D		
LT	320	1801	0.02	0.18	30.6	C	22.5	C
R	952	1478	0.18	0.64	6.8	A		

Intersection Delay = 38.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	798	244	19	4	275	249	4	16	6	109	5	145
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	219	67	5	1	80	72	3	11	4	31	2	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	877	289			325	290		70		125	6	167
%InSharedLn										0		
Prop LTs	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTs		0.073			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0		0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	798	244	19	4	275	249	4	16	6	109	5	145
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	877	268	21	5	320	290	11	43	16	125	6	167
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	877	289			325	290		70		125	6	167
Prop LTs	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTs		0.073			0.000	1.000		0.229			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.989		1.000	0.850		0.969				1.000	0.850
fLT	0.950	1.000		0.995			0.965			0.732	1.000	
Sec.	0.251											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1628		1835	1568		1995			1273	1801	1478
Sec.	456											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	L	710	1728	# 0.41	0.411	710	1.00
Perm		167	456	# 0.37	0.300	137	1.22
Left		877			0.71	847	1.04
Prot	TR						
Perm							
Thru		289	1628	0.18	0.71	1158	0.25
Right							
Westbound							
Prot	LT						
Perm							
Left							
Prot	R						
Perm							
Thru		325	1835	0.18	0.24	449	0.72
Right		290	1568	0.18	0.24	383	0.76
Northbound							
Prot	LTR						
Perm							
Left							
Prot	L						
Perm							
Thru		70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot	L						
Perm							
Left		125	1273	# 0.10	0.18	226	0.55
Prot	LT						
Perm							
Thru		6	1801	0.00	0.18	320	0.02
Right	R	167	1478	0.11	0.64	952	0.18

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.88
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.04	0.71	18.3	1.000	847	0.50	33.7	0.0	52.0	D		
TR	0.25	0.71	4.6	1.000	1158	0.50	0.3	0.0	4.9	A	40.3	D
Westbound												
LT	0.72	0.24	31.2	1.000	449	0.50	9.1	0.0	40.3	D	42.0	D
R	0.76	0.24	31.5	1.000	383	0.50	12.3	0.0	43.8	D		
Northbound												
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C
Southbound												
L	0.55	0.18	33.7	1.000	226	0.50	9.4	0.0	43.2	D		
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	22.5	C

R 0.18 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 38.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	877			125
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.02			0.16
Adjusted opposing flow rate, Vo (veh/h)	325			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.93			3.13
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.13			1.75
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	14.98			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.02			14.85
n=Max(gq-gf)/2,0)	7.49			0.58
PTHo=1-PLTo	0.98			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.77			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.13			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	14.98			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.251			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.015	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	289	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.22	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.86	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		289		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.015		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.073
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	877			
v/c ratio from Capacity Worksheet, X	1.04			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	14.98			
Unopposed green interval, gu	12.02			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.24			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	1.86			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	9.05			
Queue at beginning of unsaturated green, Qu	3.53			
Residual queue, Qr	2.93			
Uniform Delay, d1	18.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		18.3	0.00	7.5	0.0	52.0
TR	0.0	0.00	13.0	4.6	0.00	0.0	0.0	4.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.2	0.00	0.0	0.0	40.3
R	0.0	0.00	34.0	31.5	0.00	0.0	0.0	43.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	43.2
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8
Intersection Delay			38.1	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	877	289		325	290	70		125	6	167
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1191	1628		1835	1568	1995		1273	1801	1478
LnCapacity	847	1158		449	383	355		226	320	952
Flow Ratio	0.7	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	1.04	0.25		0.72	0.76	0.20		0.55	0.02	0.18
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	10.8	2.5		7.5	6.7	1.5		2.8	0.1	1.7
kB	0.6	0.8		0.6	0.5	0.6		0.4	0.5	1.1
Q2	10.3	0.3		1.5	1.5	0.1		0.5	0.0	0.2
Q Average	21.0	2.8		8.9	8.2	1.6		3.3	0.1	1.9
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	25.3	3.5		10.8	10.0	2.1		4.2	0.2	2.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5	1.5	1.6		1.6	1.7	1.6
BOQ	29.6	4.4		12.9	12.0	2.6		5.2	0.2	3.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.6	1.9		1.8	2.0	1.8
BOQ	31.7	5.0		14.1	13.1	3.0		5.9	0.3	3.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.2		1.8	1.8	2.3		2.1	2.6	2.3
BOQ	34.0	6.1		15.8	14.7	3.8		7.0	0.3	4.4
QSRatio										
98th Percentile Output:										
fB%	1.7	2.6		2.0	2.0	2.8		2.5	3.2	2.7
BOQ	36.2	7.1		17.4	16.4	4.5		8.2	0.4	5.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/2013	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2020 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	334	26	0	14	68	38	6	21	11	15	38	425
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	P				NB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
WB	Left	P				SB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		45.0						35.0			
Yellow		3.0						3.0			
All Red		2.0						2.0			

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	699	1397	0.53	0.50	18.0	B		
TR	1066	2132	0.03	0.50	11.5	B	17.5	B

LTR	1543	3086	0.10	0.50	12.0	B	12.0	B
-----	------	------	------	------	------	---	------	---

LTR	1232	3168	0.07	0.39	17.4	B	17.4	B
-----	------	------	------	------	------	---	------	---

LT	673	1730	0.10	0.39	17.8	B	24.2	C
R	616	1583	0.58	0.39	25.5	C		

Intersection Delay = 19.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	334	26	0	14	68	38	6	21	11	15	38	425
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
PK 15 Vol	92	7	0	5	24	13	3	12	6	5	13	140
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155
Adj Flow	367	29			153			84			70	355
%InSharedLn												
Prop LTs	1.000	0.000			0.124			0.155			0.286	
Prop RTs		0.000			0.261			0.286			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.970		1.000			1.000			0.974		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	334	26	0	14	68	38	6	21	11	15	38	425
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	367	29	0	19	94	40	13	47	24	20	50	355
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	367	29			153			84			70	355
Prop LTs	1.000	0.000			0.124			0.155			0.286	
Prop RTs		0.000			0.261			0.286			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.961			0.957		1.000	0.850
fLT	0.655	1.000			0.930			0.924		0.929	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1397	2132			3086			3168		1730	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	367	1397	# 0.26	0.50	699	0.53
Prot							
Perm							
Thru	TR	29	2132	0.01	0.50	1066	0.03
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	153	3086	0.05	0.50	1543	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	84	3168	0.03	0.39	1232	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	70	1730	0.04	0.39	673	0.10
Right	R	355	1583	# 0.22	0.39	616	0.58

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.55

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.53	0.50	15.3	1.000	699	0.50	2.7	0.0	18.0	B		
TR	0.03	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.5	B	17.5	B
Westbound												
LTR	0.10	0.50	11.8	1.000	1543	0.50	0.1	0.0	12.0	B	12.0	B
Northbound												
LTR	0.07	0.39	17.3	1.000	1232	0.50	0.1	0.0	17.4	B	17.4	B
Southbound												
LT	0.10	0.39	17.5	1.000	673	0.50	0.3	0.0	17.8	B	24.2	C

R 0.58 0.39 21.7 1.000 616 0.50 3.8 0.0 25.5 C

Intersection delay = 19.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	367			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.12			
Adjusted opposing flow rate, Vo (veh/h)	153			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	9.18			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.01			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.88			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.53			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.655			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	19	13	20	
Proportion of LT in LT lane group, PLT	0.000	0.124	0.155	0.286
Proportion of LT in opposing flow, PLTo	0.00	0.29	0.15	
Adjusted opposing flow rate, Vo (veh/h)	29	70	84	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.48	0.33	0.50	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.36	1.75	1.10	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.8	18.6	15.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.17	16.40	19.53	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.71	0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.26	0.31	0.29	
EL1 (refer to Exhibit C16-3)	1.42	1.48	1.51	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.08	0.07	
gdif=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95	0.94	0.93	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.930	0.924	0.929	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	153	29	70	84
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.124	0.155	0.286
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.261	0.286	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.3	0.00	0.0	0.0	18.0
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	12.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.3	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.5	0.00	0.0	0.0	17.8
R	0.0	0.00	27.5	21.7	0.00	0.0	0.0	25.5
Intersection Delay			19.4	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	367	29			80				44				70	355	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1397	2132			1620				1663				1730	1583	
LnCapacity	699	1066			810				647				673	616	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.2	
v/c Ratio	0.53	0.03			0.10				0.07				0.10	0.58	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.970			1.000				1.000				0.974		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	6.2	0.4			1.1				0.7				1.1	7.0	
kB	0.9	1.2			1.0				0.8				0.8	0.8	
Q2	0.9	0.0			0.1				0.1				0.1	1.0	
Q Average	7.2	0.4			1.2				0.8				1.2	8.0	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	8.8	0.5			1.5				1.0				1.5	9.8	
QSRatio															
85th Percentile Output:															
fB%	1.5	1.7			1.6				1.7				1.6	1.5	
BOQ	10.5	0.7			1.9				1.2				2.0	11.7	
QSRatio															
90th Percentile Output:															
fB%	1.6	2.0			1.9				1.9				1.9	1.6	
BOQ	11.6	0.8			2.2				1.5				2.3	12.9	
QSRatio															
95th Percentile Output:															
fB%	1.8	2.5			2.4				2.5				2.4	1.8	
BOQ	13.2	1.0			2.8				1.8				2.9	14.5	
QSRatio															
98th Percentile Output:															
fB%	2.1	3.1			2.9				3.0				2.9	2.0	
BOQ	14.7	1.2			3.4				2.2				3.5	16.1	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	81		4				4	90			585	250
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.19	0.32	15.7	B	15.7	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								

Northbound

LT 1663 3219 0.07 0.52 7.4 A 7.4 A

Southbound

TR 2003 3877 0.51 0.52 10.3 B 10.3 B

Intersection Delay = 10.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81		4				4	90		585	250	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	25		1				1	28		181	77	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	101		0					117			1031	
%InSharedLn												
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.300	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995					1.000			0.752		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81		4				4	90		585	250	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	101		0				5	112		722	309	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	101		0					117			1031	
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.300	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.955	
fLT	0.950				0.923		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3219		3877	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	101	1680	# 0.06	0.32	532	0.19
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	117	3219	0.04	0.52	1663	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1031	3877	# 0.27	0.52	2003	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.19	0.32	14.9	1.000	532	0.50	0.8	0.0	15.7	B	15.7	B
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B		
Westbound												
Northbound												
LT	0.07	0.52	7.3	1.000	1663	0.50	0.1	0.0	7.4	A	7.4	A
Southbound												
TR	0.51	0.52	9.5	1.000	2003	0.50	0.7	0.0	10.3	B	10.3	B

Intersection delay = 10.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.043 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1031
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.02
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	7.48
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	4.04
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.923

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			7.48	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.241	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1031	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.043	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.300
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	14.9	0.00	0.0	0.0	15.7
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.3	0.00	0.0	0.0	7.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.5	0.00	0.0	0.0	10.3
	0.0						0.0	
Intersection Delay			10.4	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	101	0				61		541	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1690		2036	
LnCapacity	532	461				873		1051	
Flow Ratio	0.1	0.0				0.0		0.3	
v/c Ratio	0.19	0.00				0.07		0.51	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	1.2	0.0				0.5		5.9	
kB	0.6	0.5				0.8		0.7	
Q2	0.1	0.0				0.1		0.7	
Q Average	1.4	0.0				0.6		6.6	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	1.7	0.0				0.7		8.1	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	2.2	0.0				0.9		9.8	
QSRatio									
90th Percentile Output:									
fB%	1.9	2.0				1.9		1.6	
BOQ	2.5	0.0				1.1		10.8	
QSRatio									
95th Percentile Output:									
fB%	2.4	2.6				2.5		1.9	
BOQ	3.2	0.0				1.4		12.4	
QSRatio									
98th Percentile Output:									
fB%	2.8	3.2				3.0		2.1	
BOQ	3.8	0.0				1.7		13.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		418	1		3			24	417	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.44	0.42	14.8	B		
LT	575	1381	0.46	0.42	15.2	B	15.0	B

Northbound

L	295	707	0.01	0.42	10.4	B	10.4	B
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Southbound

LTR	2058	4940	0.26	0.42	11.8	B	11.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		418	1		3			24	417	0
% Heavy Veh	2	2		3	3		1			1	1	1
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol	1	0		132	1		1			7	129	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			265	265		4			545		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.998		1.000				0.055	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.981			0.998		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		418	1		3			24	417	0
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	4	0		529	1		4			30	515	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			265	265		4			545		
Prop LTs	0.000			1.000 0.998			1.000			0.055		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.403		0.997	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1439 1381		707		4940	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1863	0.00	0.42	776	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	265	1439	0.18	0.42	600	0.44
Prot							
Perm							
Thru	LT	265	1381	# 0.19	0.42	575	0.46
Right							
Northbound							
Prot							
Perm							
Left	L	4	707	0.01	0.42	295	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	545	4940	# 0.11	0.42	2058	0.26
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.30
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.36

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	776	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.44	0.42	12.5	1.000	600	0.50	2.3	0.0	14.8	B		
LT	0.46	0.42	12.6	1.000	575	0.50	2.6	0.0	15.2	B	15.0	B
Northbound												
L	0.01	0.42	10.3	1.000	295	0.50	0.1	0.0	10.4	B	10.4	B
Southbound												
LTR	0.26	0.42	11.5	1.000	2058	0.50	0.3	0.0	11.8	B	11.8	B

Intersection delay = 13.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		265	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.06	
Adjusted opposing flow rate, Vo (veh/h)		4	545	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.42	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.33	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	1.99	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	23.01	
n=Max(gq-gf)/2,0)		0.00	0.99	
PTHo=1-PLTo		1.00	0.94	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.28	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	1.99	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.40	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.403	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	264		
Proportion of LT in LT lane group, PLT	0.000	0.998	0.055
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.40		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		265	265	4		200	
So	1900		1900	1900	1900		1900	
No.Lanes	0	1	0	1	0	0	0	3
SL	1863		1439	1381	707		1813	
LnCapacity	776		600	575	295		755	
Flow Ratio	0.0		0.2	0.2	0.0		0.1	
v/c Ratio	0.01		0.44	0.46	0.01		0.26	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.981		0.998	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.2	3.2	0.0		2.2	
kB	0.7		0.6	0.6	0.4		0.7	
Q2	0.0		0.5	0.5	0.0		0.3	
Q Average	0.0		3.6	3.7	0.0		2.4	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.3	
BOQ	0.1		4.5	4.6	0.1		3.1	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.6	
BOQ	0.1		5.6	5.7	0.1		3.9	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.8	
BOQ	0.1		6.3	6.4	0.1		4.4	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.1	2.6		2.2	
BOQ	0.1		7.5	7.6	0.1		5.4	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.4	3.2		2.6	
BOQ	0.1		8.8	8.9	0.1		6.4	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	25
Peak-Hour Factor, PHF	0.82
Hourly Flow Rate, HFR	30
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	168
Peak Hour Factor, PHF	0.78
Hourly Flow Rate, HFR	215
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	215
C(m) (vph)	1047
v/c	0.21
95% queue length	0.77
Control Delay	9.3
LOS	A
Approach Delay	9.3
Approach LOS	A

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		25				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		8				
Hourly Flow Rate, HFR		30				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			168			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			54			
Hourly Flow Rate, HFR			215			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					30			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	30	
Potential Capacity	1047	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1047	
Probability of Queue free St.	0.79	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.79
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.79
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	---------	---------	---------

Volume (vph)			215			
Movement Capacity (vph)			1047			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1047			
Volume			215			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					215			
C(m) (vph)					1047			
v/c					0.21			
95% queue length					0.77			
Control Delay					9.3			
LOS					A			
Approach Delay				9.3				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	62	21	134	76	0	0	0	0	13	66	28
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	103		265				56 74	
% Heavy Veh	24		5				3 3	
No. Lanes	1		1				2	
Opposing-Lanes	1		1				0	
Conflicting-lanes	2		2				1	
Geometry group	2		2				1	
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	103		265				56	74
Left-Turn	0		169				16	0
Right-Turn	26		0				0	34
Prop. Left-Turns	0.0		0.6				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.5
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	68	0	0	151	20	58	53	53	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	91		216		95		91	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	91		216		95	91		
Left-Turn	7		0		66	0		
Right-Turn	0		25		0	60		
Prop. Left-Turns	0.1		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	79	69	45	6	40	1	380	76	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	543	1551	0.34	0.35	16.1	B	15.7	B
R	549	1568	0.05	0.35	13.1	B		

Westbound

LTR	545	1558	0.11	0.35	13.6	B	13.6	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2253	4662	0.27	0.48	9.5	A	9.5	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 11.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	69	45	6	40	1	380	76	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	25	22	14	2	13	1	125	25	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		187	30		60			601				
%InSharedLn												
Prop LTs		0.535			0.133			0.832				
Prop RTs		0.000	1.000		0.017			0.002				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	69	45	6	40	1	380	76	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	100	87	30	8	51	1	500	100	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		187	30		60			601				
Prop LTs		0.535			0.133			0.832				
Prop RTs		0.000	1.000		0.017			0.002				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.971	0.971		0.990			0.971	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.998			1.000	
fLT	0.814			0.965			0.960	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1551	1568		1558			4662	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	187	1551	# 0.12	0.35	543	0.34
Right	R	30	1568	0.02	0.35	549	0.05
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1558	0.04	0.35	545	0.11
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	601	4662	# 0.13	0.48	2253	0.27
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
LT	0.34	0.35	14.4	1.000	543	0.50	1.7	0.0	16.1	B	15.7	B
R	0.05	0.35	12.9	1.000	549	0.50	0.2	0.0	13.1	B		
Westbound												
LTR	0.11	0.35	13.2	1.000	545	0.50	0.4	0.0	13.6	B	13.6	B
Northbound												
LTR	0.27	0.48	9.2	1.000	2253	0.50	0.3	0.0	9.5	A	9.5	A
Southbound												

Intersection delay = 11.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	100	8	
Proportion of LT in LT lane group, PLT	0.535	0.133	0.832
Proportion of LT in opposing flow, PLTo	0.13	0.53	
Adjusted opposing flow rate, Vo (veh/h)	60	187	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.67	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.00	3.12	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.4	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	2.44	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.58	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.87	0.47	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.53	0.13	
EL1 (refer to Exhibit C16-3)	1.47	1.68	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.814	0.965	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	2.44		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.116		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	60	187	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.535	0.133	0.832	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.017	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.4	0.00	0.0	0.0	16.1
R	0.0	0.00	19.5	12.9	0.00	0.0	0.0	13.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			11.3	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LT	R		LTR			LTR				
Init Queue		0.0	0.0		0.0			0.0				
Flow Rate		187	30		60			220				
So		1900	1900		1900			1900				
No.Lanes	0	1	1	0	1	0	0	3	0	0	0	0
SL		1551	1568		1558			1711				
LnCapacity		543	549		545			827				
Flow Ratio		0.1	0.0		0.0			0.1				
v/c Ratio		0.34	0.05		0.11			0.27				
Grn Ratio		0.35	0.35		0.35			0.48				
I Factor		0.999			0.998			0.978				
AT or PVG		3	3		3			3				
Pltn Ratio		1.00	1.00		1.00			1.00				
PF2		1.00	1.00		1.00			1.00				
Q1		2.3	0.3		0.7			2.2				
kB		0.6	0.6		0.6			0.7				
Q2		0.3	0.0		0.1			0.3				
Q Average		2.6	0.4		0.7			2.4				
Q Spacing		25.0	25.0		25.0			25.0				
Q Storage		0	0		0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3		1.3			1.3				
BOQ		3.3	0.5		1.0			3.1				
QSRatio												
85th Percentile Output:												
fB%		1.6	1.7		1.7			1.6				
BOQ		4.1	0.6		1.2			3.9				
QSRatio												
90th Percentile Output:												
fB%		1.8	2.0		1.9			1.8				
BOQ		4.7	0.7		1.4			4.4				
QSRatio												
95th Percentile Output:												
fB%		2.2	2.5		2.5			2.2				
BOQ		5.7	0.9		1.8			5.4				
QSRatio												
98th Percentile Output:												
fB%		2.6	3.1		3.0			2.6				
BOQ		6.7	1.1		2.2			6.4				
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	52		18				16	349		476	31	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	463	1737	0.20	0.27	18.0	B	18.0	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1012	1786	0.41	0.57	8.4	A	8.4	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1102	1944	0.53	0.57	9.6	A	9.6	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 9.9 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52		18				16	349		476	31	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	18		6				4	98		138	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		94						410			589	
%InSharedLn												
Prop LTs		0.745						0.044			0.000	
Prop RTs		0.255						0.000			0.061	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52		18				16	349		476	31	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	70		24				18	392		553	36	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		94						410			589	
Prop LTs		0.745						0.044			0.000	
Prop RTs		0.255						0.000			0.061	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.966						1.000			0.992		
fLT	0.964						0.970			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1737						1786			1944		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	94	1737	# 0.05	0.27	463	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	410	1786	0.23	0.57	1012	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	589	1944	# 0.30	0.57	1102	0.53
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.43

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.20	0.27	17.1	1.000	463	0.50	1.0	0.0	18.0	B	18.0	B
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1012	0.50	1.1	0.0	8.4	A	8.4	A
Southbound												
TR	0.53	0.57	8.1	1.000	1102	0.50	1.5	0.0	9.6	A	9.6	A

Intersection delay = 9.9 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.745	0.044	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		589	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.82	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.60	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.51	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.970	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.60	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.194	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			589	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.044	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.061
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	17.1	0.00	0.0	0.0 0.0 0.0	18.0
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	7.3	0.00	0.0	0.0 0.0 0.0	8.4
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	8.1	0.00	0.0	0.0 0.0 0.0	9.6
Intersection Delay			9.9	sec/veh	Intersection LOS		A	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	94						410			589		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1737						1786			1944		
LnCapacity	463						1012			1102		
Flow Ratio	0.1						0.2			0.3		
v/c Ratio	0.20						0.41			0.53		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.2						3.8			6.1		
kB	0.5						0.8			0.7		
Q2	0.1						0.5			0.8		
Q Average	1.3						4.4			6.9		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	1.7						5.5			8.5		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	2.2						6.7			10.2		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.6		
BOQ	2.5						7.5			11.3		
QSRatio												
95th Percentile Output:												
fB%	2.4						2.0			1.8		
BOQ	3.2						8.9			12.8		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.3			2.1		
BOQ	3.8						10.2			14.4		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	69		53				30	423		324	142	
Lane Width	16.0						16.0			16.0		
RTOR Vol	0									17		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	504	1513	0.30	0.33	16.3	B	16.3	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	805	1609	0.63	0.50	14.2	B	14.2	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	926	1852	0.56	0.50	12.7	B	12.7	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	69		53				30	423		324	142	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	22		17				8	119		94	41	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		152						509			522	
%InSharedLn												
Prop LTs		0.566						0.067			0.000	
Prop RTs	0.434						0.000			0.278		
Peds Bikes	0	0		0						0	0	
Buses		0						7			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	69		53				30	423		324	142	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	86		66				34	475		377	145	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		152						509			522	
Prop LTs		0.566						0.067			0.000	
Prop RTs	0.434						0.000			0.278		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.941						1.000			0.962		
fLT	0.972						0.949			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1513						1609			1852		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	152	1513	# 0.10	0.33	504	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	509	1609	# 0.32	0.50	805	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	522	1852	0.28	0.50	926	0.56
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.42

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.30	0.33	14.8	1.000	504	0.50	1.5	0.0	16.3	B	16.3	B
Westbound												
Northbound												
LT	0.63	0.50	11.0	1.000	805	0.50	3.3	0.0	14.2	B	14.2	B
Southbound												
TR	0.56	0.50	10.4	1.000	926	0.50	2.3	0.0	12.7	B	12.7	B

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		34	
Proportion of LT in LT lane group, PLT	0.566	0.067	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		522	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.57	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.70	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		11.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		7.32	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.56	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.07	
EL1 (refer to Exhibit C16-3)		2.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.949	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			7.32	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.244	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		522	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.566		0.067	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.434	0.278
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.0	0.00	0.0	0.0	14.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	10.4	0.00	0.0	0.0	12.7
	0.0						0.0	
Intersection Delay			13.8	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	152						509			522		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1513						1609			1852		
LnCapacity	504						805			926		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.30						0.63			0.56		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.9						6.2			6.1		
kB	0.5						0.6			0.8		
Q2	0.2						1.1			1.0		
Q Average	2.1						7.3			7.0		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.7						8.9			8.6		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.4						10.7			10.3		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.8						11.8			11.4		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.8			1.8		
BOQ	4.7						13.3			12.9		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.1		
BOQ	5.6						14.9			14.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		58	243	393	163	42	199		472	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	27.4	C
R	216	1620	0.34	0.13	27.7	C		
Westbound								
LTR	1314	4638	0.69	0.28	21.3	C	21.3	C
Northbound								
L	120	355	0.39	0.33	24.2	C		
T	575	1726	0.38	0.33	17.1	B	18.4	B
Southbound								
TR	662	1985	0.98	0.33	34.6	C	34.6	C

Intersection Delay = 25.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Vets Rd E & Bloomingdale Rd
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		58	243	393	163	42	199		472	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		18	69	112	46	12	55		155	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		73		908		47	221			649	
%InSharedLn												
Prop LTs					0.304		1.000	0.000			0.000	
Prop RTs			1.000		0.204			0.000			0.043	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		58	243	393	163	42	199		472	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		73	276	447	185	47	221		621	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		73		908		47	221		649		
Prop LTs					0.304		1.000	0.000		0.000		
Prop RTs			1.000		0.204			0.000		0.043		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.971	0.971	0.971	0.971	0.935	0.935	0.935	0.935
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.972	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.969	0.969		1.000	0.994	0.994
fLT	0.950		0.985	0.985	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1636	1620	4638	4638	355	1726	1985	1985
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	73	1620	# 0.05	0.13	216	0.34
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	908	4638	# 0.20	0.28	1314	0.69
Right							
Northbound							
Prot							
Perm							
Left	L	47	355	0.13	0.33	120	0.39
Prot							
Perm							
Thru	T	221	1726	0.13	0.33	575	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	649	1985	# 0.33	0.33	662	0.98
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	27.4	C	
R	0.34	0.13	23.6	1.000	216	0.50	4.1	0.0	27.7	C			
Westbound													
LTR	0.69	0.28	19.2	1.000	1314	0.50	2.2	0.0	21.3	C	21.3	C	
Northbound													
L	0.39	0.33	15.3	1.000	120	0.50	8.8	0.0	24.2	C	18.4	B	
T	0.38	0.33	15.3	1.000	575	0.50	1.8	0.0	17.1	B			
Southbound													
TR	0.98	0.33	19.8	1.000	662	0.50	14.8	0.0	34.6	C	34.6	C	

Intersection delay = 25.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			47	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			649	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			0.78	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.82	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			14.73	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.27	
n=Max(gq-gf)/2,0)			7.37	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.39	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.304 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.73	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.737	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			649	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.204	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	23.6	0.00	0.0	0.0	27.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.2	0.00	0.0	0.0	21.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.3	0.00	0.0	0.0	24.2
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.8	0.00	0.0	0.0	34.6
	0.0						0.0	
Intersection Delay			25.7	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	73		333		47	221		649
So	1900	1900		1900		1900	1900		1900
No.Lanes	1 0	1 0		3 0		1 1 0	0		1 0
SL	1636	1620		1702		355	1726		1985
LnCapacity	218	216		482		120	575		662
Flow Ratio	0.0	0.0		0.2		0.1	0.1		0.3
v/c Ratio	0.02	0.34		0.69		0.39	0.38		0.98
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.1		4.9		0.6	2.8		10.7
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	0.1		0.8		0.1	0.3		3.2
Q Average	0.1	1.2		5.7		0.7	3.2		13.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	1.6		7.1		0.9	4.0		16.8
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.7	1.6		1.4
BOQ	0.1	2.0		8.6		1.2	4.9		19.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.9		1.7		1.9	1.8		1.5
BOQ	0.1	2.4		9.5		1.4	5.6		21.3
QSRatio									
95th Percentile Output:									
fB%	2.6	2.4		1.9		2.5	2.1		1.7
BOQ	0.2	3.0		11.0		1.8	6.7		23.1
QSRatio									
98th Percentile Output:									
fB%	3.2	2.9		2.2		3.0	2.5		1.8
BOQ	0.2	3.6		12.5		2.1	7.9		24.9
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	12	39	11				5	229	98	258	483	32
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	457	1612	0.16	0.28	16.9	B	16.9	B
-----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LTR	897	1630	0.41	0.55	9.2	A	9.2	A
-----	-----	------	------	------	-----	---	-----	---

Southbound

L	533	969	0.60	0.55	11.7	B		
TR	960	1745	0.67	0.55	11.6	B	11.6	B

Intersection Delay = 11.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	12	39	11				5	229	98	258	483	32
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	4	11	3				2	64	27	81	151	10
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig			LTR						LTR	L		TR
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		73						369		322	644	
%InSharedLn												
Prop LTs			0.192						0.016	1.000	0.000	
Prop RTs		0.178						0.295			0.062	
Peds Bikes	0		0	0			0		0	0		0
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	12	39	11				5	229	98	258	483	32
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	14	46	13				6	254	109	322	604	40
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	73						369			322	644	
Prop LTs	0.192						0.016			1.000	0.000	
Prop RTs	0.178						0.295			0.062		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.971							0.935			0.935	0.935	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.972			1.000	0.992	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.976							0.960				0.991	
fLT	0.991							0.992			0.546	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1612							1630			969	1745	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	73	1612	# 0.05	0.28	457	0.16
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	369	1630	0.23	0.55	897	0.41
Right							
Southbound							
Prot							
Perm							
Left	L	322	969	0.33	0.55	533	0.60
Prot							
Perm							
Thru	TR	644	1745	# 0.37	0.55	960	0.67
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.16	0.28	16.1	1.000	457	0.50	0.7	0.0	16.9	B	16.9	B
Westbound												
Northbound												
LTR	0.41	0.55	7.9	1.000	897	0.50	1.3	0.0	9.2	A	9.2	A
Southbound												
L	0.60	0.55	9.1	1.000	533	0.50	2.6	0.0	11.7	B		
TR	0.67	0.55	9.6	1.000	960	0.50	2.0	0.0	11.6	B	11.6	B

Intersection delay = 11.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				322
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				369
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.37
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.46
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.54
n=Max(gq-gf)/2,0)				1.73
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.85
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.72
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.46
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.55
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.546

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		6	
Proportion of LT in LT lane group, PLT	0.192	0.016	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		644	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.10	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.73	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		7.93	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.14	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.65	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.93	3.46
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.240	0.105
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			644	369
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.016	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.178	0.295	0.062
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.9	0.00	0.0	0.0	9.2
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.1	0.00	0.0	0.0	11.7
TR	0.0	0.00	13.5	9.6	0.00	0.0	0.0	11.6
	0.0						0.0	

Intersection Delay	11.3	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		73						369			322	644
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1612						1630			969	1745
LnCapacity		457						897			533	960
Flow Ratio		0.0						0.2			0.3	0.4
v/c Ratio		0.16						0.41			0.60	0.67
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.941				0.518
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.9						3.6			3.6	7.7
kB		0.5						0.7			0.3	0.4
Q2		0.1						0.5			0.4	0.9
Q Average		1.0						4.1			4.0	8.5
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.3						5.1			5.0	10.4
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		1.7						6.3			6.2	12.4
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.9						7.0			7.0	13.6
QSRatio												
95th Percentile Output:												
fB%		2.4						2.0			2.0	1.8
BOQ		2.4						8.4			8.3	15.2
QSRatio												
98th Percentile Output:												
fB%		2.9						2.4			2.4	2.0
BOQ		2.9						9.7			9.6	16.8
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	20	13	172	16	104	10	182	131	138	299	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	648	1457	0.09	0.44	14.8	B	14.8	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	548	1232	0.36	0.44	18.2	B		
T	777	1749	0.02	0.44	14.1	B	17.2	B
R	574	1291	0.21	0.44	16.1	B		

Northbound

LTR	691	1554	0.52	0.44	20.4	C	20.4	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	548	1232	1.07	0.44	61.0	E	61.0	E
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 37.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	20	13	172	16	104	10	182	131	138	299	9
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	5	49	5	30	3	51	36	45	98	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		60		195	18	118		359			587	
%InSharedLn												
Prop LTs		0.200		1.000	0.000			0.031			0.310	
Prop RTs		0.317			0.000	1.000		0.407			0.020	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.966			0.850			0.090	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	20	13	172	16	104	10	182	131	138	299	9
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	12	29	19	195	18	118	11	202	146	182	393	12
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	60			195	18	118	359			587		
Prop LTs	0.200			1.000	0.000		0.031			0.310		
Prop RTs	0.317			0.000 1.000			0.407			0.020		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.971		0.952	0.952	0.952	0.935		0.935		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.957		1.000 0.850			0.945		0.997		
fLT	0.968		0.718	1.000		0.980		0.702		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.991		
fRpb	0.982		1.000 1.000			0.977		1.000		
S	1457		1232	1749	1291	1554		1232		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1457	0.04	0.44	648	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	195	1232	# 0.16	0.44	548	0.36
Prot							
Perm							
Thru	T	18	1749	0.01	0.44	777	0.02
Right	R	118	1291	0.09	0.44	574	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	359	1554	0.23	0.44	691	0.52
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	587	1232	# 0.48	0.44	548	1.07
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	648	0.50	0.3	0.0	14.8	B	14.8	B
Westbound												
L	0.36	0.44	16.5	1.000	548	0.50	1.7	0.0	18.2	B		
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B	17.2	B
R	0.21	0.44	15.3	1.000	574	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.52	0.44	18.1	1.000	691	0.50	2.4	0.0	20.4	C	20.4	C
Southbound												
LTR	1.07	0.44	25.0	1.000	548	0.50	36.0	0.0	61.0	E	61.0	E

Intersection delay = 37.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		195		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.20		
Adjusted opposing flow rate, Vo (veh/h)		60		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		4.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.50		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.80		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.718		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	12	11	182
Proportion of LT in LT lane group, PLT	0.200	0.000	0.031 0.310
Proportion of LT in opposing flow, PLTo	0.00	0.31	0.03
Adjusted opposing flow rate, Vo (veh/h)	18	587	359
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.30	0.28	4.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45	14.68	8.98
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.6	22.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.52	9.10
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.43	17.69	30.90
n=Max(gq-gf)/2,0)	0.00	0.00	4.55
PTHo=1-PLTo	1.00	0.69	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.20	0.03	0.31
EL1 (refer to Exhibit C16-3)	1.40	2.51	2.00
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.31
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.07
gdifff=max(gq-gf,0)	0.00	0.00	9.10
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.98	0.70
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.968	0.980	0.702

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.52	9.10
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.388	0.228
OCCpedu	0.000	0.056	0.000	0.050
Opposing flow rate, Vo (veh/h)	18	60	587	359
OCCr	0.000	0.052	0.000	0.030
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.970
Proportion of left turns, PLT	0.200	1.000	0.031	0.310
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.991
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.317	1.000	0.407	0.020
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.977	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.8
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	16.5	0.00	0.0	0.0	18.2
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	18.1	0.00	0.0	0.0	20.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	9.7	0.0	61.0
	0.0						0.0	
Intersection Delay			37.2	sec/veh	Intersection LOS		D	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		60	195	18	118		359		587
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1457	1232	1749	1291		1554		1232
LnCapacity		648	548	777	574		691		548
Flow Ratio		0.0	0.2	0.0	0.1		0.2		0.5
v/c Ratio		0.09	0.36	0.02	0.21		0.52		1.07
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.9	3.2	0.3	1.8		6.5		14.7
kB		0.8	0.7	0.9	0.7		0.7		0.1
Q2		0.1	0.4	0.0	0.2		0.8		5.7
Q Average		1.0	3.6	0.3	2.0		7.3		20.4
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.2	4.5	0.4	2.5		8.9		24.5
QSRatio									
85th Percentile Output:									
fB%		1.6	1.5	1.7	1.6		1.5		1.4
BOQ		1.6	5.6	0.5	3.2		10.7		28.7
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		1.8	6.3	0.5	3.7		11.8		30.8
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.8		1.6
BOQ		2.3	7.5	0.7	4.5		13.3		33.0
QSRatio									
98th Percentile Output:									
fB%		2.9	2.4	3.1	2.7		2.0		1.7
BOQ		2.8	8.8	0.9	5.4		14.9		35.2
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	141	188		90	174		224		83			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				NB Thru			
	Right	P				NB Right	P		
	Peds					NB Peds			
WB	Left	P				SB Left			
	Thru	P				SB Thru			
	Right					SB Right			
	Peds					SB Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	894	1787	0.35	0.50	14.6	B	14.6	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	726	1452	0.41	0.50	15.8	B	15.8	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	533	1371	0.61	0.39	26.5	C	26.5	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 19.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		141	188	90	174		224		83			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		38	51	25	49		60		22			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		310			297			326				
%InSharedLn												
Prop LTs		0.000			0.340			0.730				
Prop RTs		0.506			0.000			0.270				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		141	188	90	174		224		83			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		153	157	101	196		238		88			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		310			297			326				
Prop LTs		0.000			0.340			0.730				
Prop RTs		0.506			0.000			0.270				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.932			1.000			0.964					
fLT	1.000			0.762			0.965					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1787			1452			1371					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.35	0.50	13.6	1.000	894	0.50	1.0	0.0	14.6	B	14.6	B
Westbound												
LT	0.41	0.50	14.1	1.000	726	0.50	1.7	0.0	15.8	B	15.8	B
Northbound												
LR	0.61	0.39	22.1	1.000	533	0.50	4.4	0.0	26.5	C	26.5	C
Southbound												

Intersection delay = 19.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	101		
Proportion of LT in LT lane group, PLT	0.000	0.340	0.730
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	310		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	2.53		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.75		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	4.6		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	6.28		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	38.72		
n=Max(gq-gf)/2,0)	0.82		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.34		
EL1 (refer to Exhibit C16-3)	1.90		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.76		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.762		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	TR			LT			LR					
Init Queue	0.0			0.0			0.0					
Flow Rate	310			297			326					
So	1900			1900			1900					
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	
SL	1787			1452			1371					
LnCapacity	894			726			533					
Flow Ratio	0.2			0.2			0.2					
v/c Ratio	0.35			0.41			0.61					
Grn Ratio	0.50			0.50			0.39					
I Factor	0.964			0.986			0.858					
AT or PVG	3			3			3					
Pltn Ratio	1.00			1.00			1.00					
PF2	1.00			1.00			1.00					
Q1	4.7			4.7			6.5					
kB	1.0			0.9			0.6					
Q2	0.5			0.6			1.0					
Q Average	5.2			5.3			7.5					
Q Spacing	25.0			25.0			25.0					
Q Storage	0			0			0					
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.2			1.2					
BOQ	6.5			6.5			9.2					
QSRatio												
85th Percentile Output:												
fB%	1.5			1.5			1.5					
BOQ	7.9			7.9			11.0					
QSRatio												
90th Percentile Output:												
fB%	1.7			1.7			1.6					
BOQ	8.8			8.8			12.1					
QSRatio												
95th Percentile Output:												
fB%	2.0			1.9			1.8					
BOQ	10.2			10.3			13.7					
QSRatio												
98th Percentile Output:												
fB%	2.2			2.2			2.0					
BOQ	11.6			11.7			15.2					
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	24	17	39	35	19	25	36	221	36	32	235	23
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 229 1963 0.45 0.12 31.0 C 31.0 C

Westbound

LTR 459 1835 0.20 0.25 18.7 B 18.7 B

Northbound

LTR 689 1798 0.50 0.38 16.7 B 16.7 B

Southbound

LTR 639 1668 0.50 0.38 16.9 B 16.9 B

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24	17	39	35	19	25	36	221	36	32	235	23
% Heavy Veh	1	1	1	10	10	10	8	8	8	18	18	18
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
PK 15 Vol	8	5	13	10	5	7	11	65	11	9	65	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		103			90			344			318	
%InSharedLn												
Prop LTs		0.301			0.444			0.122			0.110	
Prop RTs		0.485			0.311			0.122			0.079	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			3			3	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	24	17	39	35	19	25	36	221	36	32	235	23
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
Adj flow	31	22	50	40	22	28	42	260	42	35	258	25
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	103			90			344			318		
Prop LTs	0.301			0.444			0.122			0.110		
Prop RTs	0.485			0.311			0.122			0.079		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.990			0.909			0.926			0.847		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.988			0.988		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.934			0.958			0.984			0.989		
fLT	0.985			0.978			0.928			0.935		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1963			1835			1798			1668		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	103	1963	# 0.05	0.12	229	0.45
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	90	1835	# 0.05	0.25	459	0.20
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	344	1798	# 0.19	0.38	689	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	318	1668	0.19	0.38	639	0.50
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.29$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.39$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.45	0.12	24.7	1.000	229	0.50	6.3	0.0	31.0	C	31.0	C
Westbound												
LTR	0.20	0.25	17.7	1.000	459	0.50	1.0	0.0	18.7	B	18.7	B
Northbound												
LTR	0.50	0.38	14.1	1.000	689	0.50	2.6	0.0	16.7	B	16.7	B
Southbound												
LTR	0.50	0.38	14.1	1.000	639	0.50	2.8	0.0	16.9	B	16.9	B

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			42	35
Proportion of LT in LT lane group, PLT	0.301	0.444	0.122	0.110
Proportion of LT in opposing flow, PLTo			0.11	0.12
Adjusted opposing flow rate, Vo (veh/h)			318	344
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.70	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.30	5.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.6	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			5.55	6.20
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.43	15.54
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.89	0.88
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.12	0.11
EL1 (refer to Exhibit C16-3)			1.92	1.97
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.93	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.928	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.20
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.269
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				344
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.110
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.485	0.122
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.7	0.00	0.0	0.0	31.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.7	0.00	0.0	0.0	18.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.1	0.00	0.0	0.0	16.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.1	0.00	0.0	0.0	16.9
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	103		90		344		318	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0	0 1 0	0	0 1 0	0	0 1 0	
SL	1963		1835		1798		1668	
LnCapacity	229		459		689		639	
Flow Ratio	0.1		0.0		0.2		0.2	
v/c Ratio	0.45		0.20		0.50		0.50	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.6		1.2		4.4		4.0	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.1		0.7		0.6	
Q Average	1.8		1.3		5.0		4.7	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.3		1.7		6.2		5.8	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	3.0		2.1		7.6		7.1	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.9		1.7		1.7	
BOQ	3.4		2.5		8.5		7.9	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.4		2.0		2.0	
BOQ	4.2		3.1		9.9		9.3	
QSRatio								
98th Percentile Output:								
fB%	2.7		2.9		2.2		2.3	
BOQ	5.1		3.7		11.3		10.7	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			278	18		19	289	
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91	
Hourly Flow Rate, HFR			327	21		20	317	
Percent Heavy Vehicles			--	--		15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		44		15				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		46		15				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB			SB			Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12				
Lane Config		LT		LR								
v (vph)		20		61								
C(m) (vph)		1142		452								
v/c		0.02		0.13								
95% queue length		0.05		0.46								
Control Delay		8.2		14.2								
LOS		A		B								
Approach Delay				14.2								
Approach LOS				B								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume		278	18	19	289	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		82	5	5	79	
Hourly Flow Rate, HFR		327	21	20	317	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume	44		15			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	12		4			
Hourly Flow Rate, HFR	46		15			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
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Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		317
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		348	695		338			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	338	
Potential Capacity	709	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	709	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	348	
Potential Capacity	1142	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1142	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	695	
Potential Capacity	411	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	404	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 695
Potential Capacity 411
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 404

Results for Two-stage process:
a
y
C t 404

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	46		15			
Movement Capacity (vph)	404		709			
Shared Lane Capacity (vph)		452				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	404		709			
Volume	46		15			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		452				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		20		61				
C(m) (vph)		1142		452				
v/c		0.02		0.13				
95% queue length		0.05		0.46				
Control Delay		8.2		14.2				
LOS		A		B				
Approach Delay				14.2				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		317
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	276	24	388	1	145	274	152	180	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	713	1711	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	522	1253	0.64	0.42	19.2	B	24.5	C
R	518	1244	0.83	0.42	28.7	C		

Northbound

LTR	706	1695	0.65	0.42	18.2	B	18.2	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	471	1131	0.82	0.42	30.4	C	30.4	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 23.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	276	24	388	1	145	274	152	180	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	77	7	108	1	39	74	44	52	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			334	431		457			387	
%InSharedLn												
Prop LTs		0.036			0.919			0.002			0.457	
Prop RTs		0.250			0.000	1.000		0.652			0.003	
Peds Bikes	0			0	0		0			0	0	
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	276	24	388	1	145	274	152	180	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	307	27	431	1	158	298	177	209	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			334 431			457			387		
Prop LTs	0.036			0.919			0.002			0.457		
Prop RTs	0.250			0.000 1.000			0.652			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.912			1.000		
fLT	0.992			0.723			0.999			0.571		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1711			1253 1244			1695			1131		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1711	0.02	0.42	713	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	334	1253	0.27	0.42	522	0.64
Right	R	431	1244	# 0.35	0.42	518	0.83
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	457	1695	0.27	0.42	706	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	387	1131	# 0.34	0.42	471	0.82
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.42	10.4	1.000	713	0.50	0.1	0.0	10.5	B	10.5	B	
Westbound													
LT	0.64	0.42	13.9	1.000	522	0.50	5.3	0.0	19.2	B	24.5	C	
R	0.83	0.42	15.6	1.000	518	0.50	13.0	0.0	28.7	C			
Northbound													
LTR	0.65	0.42	14.0	1.000	706	0.50	4.2	0.0	18.2	B	18.2	B	
Southbound													
LTR	0.82	0.42	15.5	1.000	471	0.50	14.9	0.0	30.4	C	30.4	C	

Intersection delay = 23.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	307	1	177
Proportion of LT in LT lane group, PLT	0.036	0.919	0.002	0.457
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.46	0.00
Adjusted opposing flow rate, Vo (veh/h)	334	28	387	457
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.12	0.02	2.95
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.57	0.47	6.45	7.62
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.32	0.00	6.55	8.11
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	16.89
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.05
PTHo=1-PLTo	0.08	0.96	0.54	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	0.46
EL1 (refer to Exhibit C16-3)	1.95	1.42	2.05	2.20
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.04
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	8.11
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.57
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.723	0.999	0.571

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.32		6.55	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.213		0.262	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	334		387	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.9	0.00	0.0	0.0	19.2
R	0.0	0.00	17.5	15.6	0.00	0.0	0.0	28.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.0	0.00	0.0	0.0	18.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.5	0.00	0.0	0.0	30.4
	0.0						0.0	
Intersection Delay			23.9	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	28			334	431	457		387	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1711			1253	1244	1695		1131	
LnCapacity	713			522	518	706		471	
Flow Ratio	0.0			0.3	0.3	0.3		0.3	
v/c Ratio	0.04			0.64	0.83	0.65		0.82	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.887		0.931		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.3			4.4	6.4	6.1		5.7	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			0.8	2.0	1.1		2.0	
Q Average	0.3			5.3	8.4	7.2		7.7	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.4			6.5	10.3	8.8		9.4	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.5	1.5	1.5		1.5	
BOQ	0.5			7.9	12.3	10.6		11.3	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.7	1.6	1.6		1.6	
BOQ	0.6			8.8	13.4	11.6		12.4	
QSRatio									
95th Percentile Output:									
fB%	2.5			1.9	1.8	1.8		1.8	
BOQ	0.8			10.3	15.0	13.2		14.0	
QSRatio									
98th Percentile Output:									
fB%	3.1			2.2	2.0	2.1		2.0	
BOQ	0.9			11.7	16.7	14.8		15.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: Philip Habib & Associates
 Date: 6/19/2013
 Period: Weekday 12-1 PM MD Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				324		3		416			463	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.58 0.33 19.7 B 19.7 B

Northbound

T 970 1940 0.47 0.50 11.2 B 11.2 B

Southbound

T 946 1892 0.57 0.50 11.9 B 11.9 B

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: Philip Habib & Associates
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				324		3	416			463		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				92		1	113			135		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					371		452			538		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				324		3	416			463		
PHF				0.88		0.88	0.92			0.86		
Adj flow				368		3	452			538		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					371			452			538	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	371	1933	# 0.19	0.33	644	0.58
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	452	1940	0.23	0.50	970	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	538	1892	# 0.28	0.50	946	0.57
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.48
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.58	0.33	16.5	1.000	644	0.50	3.2	0.0	19.7	B	19.7	B
Northbound												
T	0.47	0.50	9.8	1.000	970	0.50	1.4	0.0	11.2	B	11.2	B
Southbound												
T	0.57	0.50	10.5	1.000	946	0.50	1.4	0.0	11.9	B	11.9	B

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.5	0.00	0.0	0.0	19.7
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.5	0.00	0.0	0.0	11.9
	0.0						0.0	
Intersection Delay			13.8	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		416	240			140	647	
Peak-Hour Factor, PHF		0.92	0.92			0.86	0.86	
Hourly Flow Rate, HFR		452	260			162	752	
Percent Heavy Vehicles		--	--			16	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		162						
C(m) (vph)		826						
v/c		0.20						
95% queue length		0.73						
Control Delay		10.4						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		416	240	140	647	
Peak-Hour Factor, PHF		0.92	0.92	0.86	0.86	
Peak-15 Minute Volume		113	65	41	188	
Hourly Flow Rate, HFR		452	260	162	752	
Percent Heavy Vehicles		--	--	16	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		752
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		712						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	712	
Potential Capacity	826	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	826	
Probability of Queue free St.	0.80	1.00
Maj L-Shared Prob Q free St.	0.65	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.65	0.65
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.80	0.80
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.65 0.65
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.80 0.80
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R

Volume (vph)
Movement Capacity (vph)
Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		162						
C(m) (vph)		826						
v/c		0.20						
95% queue length		0.73						
Control Delay		10.4						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.80
v(i1), Volume for stream 2 or 5		752
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.65
d(M,LT), Delay for stream 1 or 4		10.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		3.7

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				101		203	441	79		191	438	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 385 1445 0.91 0.27 47.6 D 47.6 D

Northbound

TR 1057 1865 0.53 0.57 9.8 A 9.8 A

Southbound

LT 623 1099 1.17 0.57 99.8 F 99.8 F

Intersection Delay = 57.8 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				101		203	441	79		191	438	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				29		58	120	21		56	127	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					349			565			731	
%InSharedLn												
Prop LTs					0.332			0.000			0.304	
Prop RTs					0.668			0.152			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				101		203	441	79		191	438	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				116		233	479	86		222	509	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					349			565			731	
Prop LTs					0.332			0.000			0.304	
Prop RTs					0.668			0.152			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.910			0.979			1.000	
fLT					0.984			1.000			0.567	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1445			1865			1099	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	349	1445	# 0.24	0.27	385	0.91
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	565	1865	0.30	0.57	1057	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	731	1099	# 0.67	0.57	623	1.17
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.09

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.91	0.27	21.3	1.000	385	0.50	26.3	0.0	47.6	D	47.6	D
Northbound												
TR	0.53	0.57	8.1	1.000	1057	0.50	1.7	0.0	9.8	A	9.8	A
Southbound												
LT	1.17	0.57	13.0	1.000	623	0.50	86.8	0.0	99.8	F	99.8	F

Intersection delay = 57.8 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			222
Proportion of LT in LT lane group, PLT	0.332	0.000	0.304
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			565
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.42
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			6.24
gu=g-gq if gq>=gf, or = g-gf if gq<gf			27.76
n=Max(gq-gf)/2,0)			3.12
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.30
EL1 (refer to Exhibit C16-3)			2.45
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.57
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.567

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.24
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.184
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				565
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.304
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.668	0.152
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.3	0.00	0.0	0.0	47.6
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.1	0.00	0.0	0.0	9.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	27.0	0.0	99.8
	0.0						0.0	
Intersection Delay			57.8	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	144	65	91	39	176	73	105	568	136	122	451	69
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 420 1219 0.83 0.34 38.9 D 38.9 D

Westbound

LTR 549 1593 0.57 0.34 28.3 C 28.3 C

Northbound

L 321 590 0.36 0.54 13.9 B
 TR 1050 1929 0.74 0.54 19.0 B 18.3 B

Southbound

LTR 890 1635 0.79 0.54 23.5 C 23.5 C

Intersection Delay = 24.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Richmond Valley Rd & Page Ave
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	144	65	91	39	176	73	105	568	136	122	451	69
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	42	19	26	11	48	20	29	156	37	34	127	19
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		349			312		115	773			706	
%InSharedLn												
Prop LTs		0.479			0.135		1.000	0.000			0.194	
Prop RTs		0.304			0.253			0.193			0.088	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	144	65	91	39	176	73	105	568	136	122	451	69
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	167	76	106	42	191	79	115	624	149	137	507	62
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	349			312			115 773			706		
Prop LTs	0.479			0.135			1.000 0.000			0.194		
Prop RTs	0.304			0.253			0.193			0.088		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.959			0.966			0.971			0.987		
fLT	0.608			0.920			0.340 1.000			0.545		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1219			1593			590 1929			1635		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	349	1219	# 0.29	0.34	420	0.83
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	312	1593	0.20	0.34	549	0.57
Right							
Northbound							
Prot							
Perm							
Left	L	115	590	0.19	0.54	321	0.36
Prot							
Perm							
Thru	TR	773	1929	0.40	0.54	1050	0.74
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	706	1635	# 0.43	0.54	890	0.79
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.72
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.83	0.34	27.1	1.000	420	0.50	11.8	0.0	38.9	D	38.9	D	
Westbound													
LTR	0.57	0.34	24.0	1.000	549	0.50	4.2	0.0	28.3	C	28.3	C	
Northbound													
L	0.36	0.54	11.6	1.000	321	0.50	2.3	0.0	13.9	B			
TR	0.74	0.54	15.6	1.000	1050	0.50	3.4	0.0	19.0	B	18.3	B	
Southbound													
LTR	0.79	0.54	16.4	1.000	890	0.50	7.0	0.0	23.5	C	23.5	C	

Intersection delay = 24.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			115	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.19	
Adjusted opposing flow rate, Vo (veh/h)			706	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.88	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.27	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			5.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			43.36	
n=Max(gq-gf)/2,0)			2.82	
PTHo=1-PLTo			0.81	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.61	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.35	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			5.64	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.34	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.340	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	167	42	137
Proportion of LT in LT lane group, PLT	0.479	0.135	0.000
Proportion of LT in opposing flow, PLTo	0.13	0.48	0.00
Adjusted opposing flow rate, Vo (veh/h)	312	349	773
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	4.18	1.05	3.43
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.80	8.73	19.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	0.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	10.11	11.45	25.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.89	19.55	23.14
n=Max(gq-gf)/2,0)	5.05	1.84	12.52
PTHo=1-PLTo	0.87	0.52	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.48	0.13	0.94
EL1 (refer to Exhibit C16-3)	1.90	1.98	3.00
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.85	1.46	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.07	0.08
gdifff=max(gq-gf,0)	10.11	3.68	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.61	0.92	0.18
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.608	0.920	0.545

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	10.11	11.45	5.64	25.86
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.326	0.369	0.115	0.528
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	312	349	706	773
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.479	0.135	1.000	0.194
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.304	0.253	0.193	0.088
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	27.1	0.00	0.0	0.0 0.0 0.0	38.9
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.0	0.00	0.0	0.0 0.0 0.0	28.3
Northbound								
L	0.0	0.00	20.5	11.6	0.00	0.0	0.0	13.9
TR	0.0 0.0	0.00	20.5	15.6	0.00	0.0	0.0 0.0	19.0
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	16.4	0.00	0.0	0.0 0.0 0.0	23.5
Intersection Delay			24.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	349		312		115	773	370	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 1 0	1 0		1 1 0		0 2 0	
SL	1219		1593		590	1929	858	
LnCapacity	420		549		321	1050	467	
Flow Ratio	0.3		0.2		0.2	0.4	0.4	
v/c Ratio	0.83		0.57		0.36	0.74	0.79	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	8.0		6.4		1.6	14.7	7.4	
kB	0.4		0.8		0.4	0.9	0.7	
Q2	1.7		1.0		0.2	2.3	2.1	
Q Average	9.7		7.3		1.8	17.0	9.5	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	11.8		8.9		2.3	20.4	11.6	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.5		1.6	1.4	1.4	
BOQ	14.0		10.7		3.0	23.9	13.8	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.8	1.5	1.6	
BOQ	15.2		11.8		3.4	25.7	15.0	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.8		2.3	1.6	1.7	
BOQ	16.9		13.4		4.2	27.7	16.7	
QSRatio								
98th Percentile Output:								
fB%	1.9		2.0		2.7	1.8	1.9	
BOQ	18.6		15.0		5.0	29.7	18.3	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 No-Action Conditions

N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	291						785			552		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	662	1986	0.50	0.33	26.7	C	26.7	C

Westbound

Northbound

T	2134	3842	0.40	0.56	11.9	B	11.9	B
---	------	------	------	------	------	---	------	---

Southbound

T	1951	3512	0.32	0.56	11.2	B	11.2	B
---	------	------	------	------	------	---	------	---

Intersection Delay = 14.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	291						785			552		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	83						216			155		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	331						863			620		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	291						785			552		
PHF	0.88						0.91			0.89		
Adj flow	331						863			620		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	331						863			620		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.971						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	1986						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	331	1986	# 0.17	0.33	662	0.50
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	863	3842	# 0.22	0.56	2134	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	620	3512	0.18	0.56	1951	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.44

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.50	0.33	24.0	1.000	662	0.50	2.7	0.0	26.7	C	26.7	C	
Westbound													
Northbound													
T	0.40	0.56	11.5	1.000	2134	0.50	0.4	0.0	11.9	B	11.9	B	
Southbound													
T	0.32	0.56	10.8	1.000	1951	0.50	0.4	0.0	11.2	B	11.2	B	

Intersection delay = 14.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	24.0	0.00	0.0	0.0	26.7
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.5	0.00	0.0	0.0	11.9
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Intersection Delay			14.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	331						453		325	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.50						0.40		0.32	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.6						6.5		4.4	
kB	0.9						0.9		1.1	
Q2	0.8						0.6		0.5	
Q Average	7.5						7.1		4.9	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	9.1						8.7		6.1	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.9						10.5		7.4	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	12.0						11.5		8.3	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		2.0	
BOQ	13.6						13.1		9.7	
QSRatio										
98th Percentile Output:										
fB%	2.0						2.1		2.3	
BOQ	15.2						14.7		11.1	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						552	
Peak-Hour Factor, PHF						0.89	
Hourly Flow Rate, HFR						620	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							90
Peak Hour Factor, PHF							0.84
Hourly Flow Rate, HFR							107
Percent Heavy Vehicles							29
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage							/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound	
	1	4	7	8	9	10	11
Lane Config							12
							R
v (vph)							107
C(m) (vph)							671
v/c							0.16
95% queue length							0.56
Control Delay							11.4
LOS							B
Approach Delay						11.4	
Approach LOS						B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					552	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					155	
Hourly Flow Rate, HFR					620	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						90
Peak Hour Factor, PHF						0.84
Peak-15 Minute Volume						27
Hourly Flow Rate, HFR						107
Percent Heavy Vehicles						29
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								310
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		310
Potential Capacity		671
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		671
Probability of Queue free St.	1.00	0.84

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	483
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	483
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	483	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	483	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	540
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	540

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	748	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity	629	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						107
Movement Capacity (vph)						671
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						671
Volume						107
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								107
C(m) (vph)								671
v/c								0.16
95% queue length								0.56
Control Delay								11.4
LOS								B
Approach Delay							11.4	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 No-Action Conditions

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	93	225	144	215	594	83	105	199	223	148	49	40
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	139	418	0.80	0.33	59.6	E		
TR	596	1788	0.67	0.33	30.9	C	37.1	D
Westbound								
L	174	522	1.37	0.33	228.0	F		
TR	1120	3359	0.66	0.33	28.5	C	77.3	E
Northbound								
LTR	911	3279	0.62	0.28	31.6	C	31.6	C
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	360	1621	0.31	0.22	31.4	C	33.6	C

Intersection Delay = 52.0 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Veterans Rd W & Bricktown/KWVP
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
E/W St: Veterans Road West

N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93	225	144	215	594	83	105	199	223	148	49	40
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	28	67	43	60	165	23	28	53	60	46	15	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	111	401		239	738			567		185	111	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.199			0.000	
Prop RTs		0.332			0.106			0.423			0.450	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	93	225	144	215	594	83	105	199	223	148	49	40
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	111	268	133	239	660	78	113	214	240	185	61	50
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	111	401		239	738			567		185	111	
Prop LTs	1.000	0.000		1.000	0.000			0.199			0.000	
Prop RTs		0.332			0.106			0.423			0.450	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.990	0.990		0.943	0.943			0.962		0.980	0.980	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.950			0.984			0.937			0.932	
fLT	0.230	1.000		0.312	1.000			0.990		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	418	1788		522	3359			3279		1711	1621	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	111	418	0.27	0.33	139	0.80
Prot							
Perm							
Thru	TR	401	1788	0.22	0.33	596	0.67
Right							
Westbound							
Prot							
Perm							
Left	L	239	522	# 0.46	0.33	174	1.37
Prot							
Perm							
Thru	TR	738	3359	0.22	0.33	1120	0.66
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	567	3279	# 0.17	0.28	911	0.62
Right							
Southbound							
Prot							
Perm							
Left	L	185	1711	# 0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	111	1621	0.07	0.22	360	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.80	0.33	27.3	1.000	139	0.50	32.4	0.0	59.6	E		
TR	0.67	0.33	25.8	1.000	596	0.50	5.1	0.0	30.9	C	37.1	D
Westbound												
L	1.37	0.33	30.0	1.000	174	0.50	198.0	0.0	228.0	F		
TR	0.66	0.33	25.6	1.000	1120	0.50	2.8	0.0	28.5	C	77.3	E
Northbound												
LTR	0.62	0.28	28.4	1.000	911	0.50	3.2	0.0	31.6	C	31.6	C
Southbound												
L	0.49	0.22	30.5	1.000	380	0.50	4.3	0.0	34.9	C		
TR	0.31	0.22	29.2	1.000	360	0.50	2.2	0.0	31.4	C	33.6	C

Intersection delay = 52.0 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	111	239		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	738	401		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	2.78	5.98		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.69	10.02		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	11.47	12.20		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.53	17.80		
n=Max(gq-gf)/2,0)	5.73	6.10		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.69	1.90		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.31		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.230	0.312		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.199 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	11.47			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.382			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	738			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	27.3	0.00	0.0	0.0	59.6
TR	0.0	0.00	30.0	25.8	0.00	0.0	0.0	30.9
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	16.2	0.0	228.0
TR	0.0	0.00	30.0	25.6	0.00	0.0	0.0	28.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.4	0.00	0.0	0.0	31.6
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	29.2	0.00	0.0	0.0	31.4
	0.0						0.0	

Intersection Delay	52.0	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	111	401		239	387		297			185	111	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	418	1788		522	1764		1722			1711	1621	
LnCapacity	139	596		174	588		478			380	360	
Flow Ratio	0.3	0.2		0.5	0.2		0.2			0.1	0.1	
v/c Ratio	0.80	0.67		1.37	0.66		0.62			0.49	0.31	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.5	8.6		6.0	8.3		6.5			4.0	2.3	
kB	0.2	0.7		0.3	0.7		0.7			0.6	0.6	
Q2	0.8	1.3		9.1	1.3		1.1			0.5	0.2	
Q Average	3.3	9.9		15.1	9.6		7.5			4.6	2.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.2	1.3	
BOQ	4.2	12.1		18.2	11.7		9.2			5.7	3.2	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.4	1.4		1.5			1.5	1.6	
BOQ	5.2	14.3		21.4	13.9		11.1			6.9	4.0	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.5	1.6		1.6			1.7	1.8	
BOQ	5.8	15.6		23.0	15.1		12.2			7.8	4.6	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7		1.6	1.7		1.8			2.0	2.2	
BOQ	7.0	17.3		24.9	16.8		13.7			9.1	5.6	
QSRatio												
98th Percentile Output:												
fB%	2.5	1.9		1.8	1.9		2.0			2.3	2.6	
BOQ	8.2	18.9		26.8	18.4		15.3			10.5	6.7	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						407			
Peak-Hour Factor, PHF						0.87			
Hourly Flow Rate, HFR						467			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		133							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		143							
Percent Heavy Vehicles		4							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			143							
C(m) (vph)			551							
v/c			0.26							
95% queue length			1.03							
Control Delay			13.8							
LOS			B							
Approach Delay				13.8						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 407
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 117
 Hourly Flow Rate, HFR 467
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 133
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 36
 Hourly Flow Rate, HFR 143
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	467	
Potential Capacity	551	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	551	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 467
Potential Capacity 551
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 551

Results for Two-stage process:
a
y
C t 551

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	143					
Movement Capacity (vph)	551					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	551					
Volume	143					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			143					
C(m) (vph)			551					
v/c			0.26					
95% queue length			1.03					
Control Delay			13.8					
LOS			B					
Approach Delay				13.8				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	115	32	130	125	0	40	0	41	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.88	0.88	0.90	0.90	0.78	0.78		
Flow Rate	64	101	212	70	51	52		
% Heavy Veh	42	42	4	4	3	3		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	64	101	212	70	51	52		
Left-Turn	0	0	144	0	51	0		
Right-Turn	0	36	0	0	0	52		
Prop. Left-Turns	0.0	0.0	0.7	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.4	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	62	120	387	225	395	18	276	155	88	23	311	225
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 810 3168 0.84 0.26 40.8 D 40.8 D

Westbound

LTR 878 3437 0.81 0.26 38.8 D 38.8 D

Northbound

DefL 181 561 1.75 0.32 390.4 F
 TR 581 1803 0.48 0.32 27.3 C 220.4 F

Southbound

LTR 836 2593 0.74 0.32 33.1 C 33.1 C

Intersection Delay = 79.5 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	120	387	225	395	18	276	155	88	23	311	225
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	36	115	63	110	5	79	45	25	6	86	63
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		678			709		317	279			622	
%InSharedLn												
Prop LTs		0.109			0.353		1.000	0.000			0.042	
Prop RTs		0.680			0.028			0.362			0.402	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	120	387	225	395	18	276	155	88	23	311	225
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	74	143	461	250	439	20	317	178	101	26	346	250
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	678			709			317 279			622		
Prop LTs	0.109			0.353			1.000 0.000			0.042		
Prop RTs	0.680			0.028			0.362			0.402		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.898			0.996			0.946			0.940		
fLT	0.995			0.983			0.294 1.000			0.932		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3168			3437			561 1803			2593		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	678	3168	# 0.21	0.26	810	0.84
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	709	3437	# 0.21	0.26	878	0.81
Right							
Northbound							
Prot							
Perm							
Left	DefL	317	561	# 0.57	0.32	181	1.75
Prot							
Perm							
Thru	TR	279	1803	0.15	0.32	581	0.48
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	622	2593	0.24	0.32	836	0.74
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.99
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.18

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.84	0.26	31.7	1.000	810	0.50	9.0	0.0	40.8	D	40.8	D
Westbound												
LTR	0.81	0.26	31.4	1.000	878	0.50	7.4	0.0	38.8	D	38.8	D
Northbound												
DefL	1.75	0.32	30.5	1.000	181	0.50	359.9	0.0	390.4	F		
TR	0.48	0.32	24.5	1.000	581	0.50	2.8	0.0	27.3	C	220.4	F
Southbound												
LTR	0.74	0.32	27.2	1.000	836	0.50	6.0	0.0	33.1	C	33.1	C

Intersection delay = 79.5 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			317	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			622	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.93	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.17	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			8.53	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			20.47	
n=Max(gq-gf)/2,0)			4.26	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.40	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.98	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			8.53	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.294	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	26
Proportion of LT in LT lane group, PLT	0.109 0.353 0.000 0.042
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	279
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.65
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.49
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.82
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	1.84
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.932

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.12
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.004
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				279
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.042
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.680	0.028	0.362
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	31.7	0.00	0.0	0.0 0.0 0.0	40.8
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	31.4	0.00	0.0	0.0 0.0 0.0	38.8
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	34.0	0.0	390.4
TR	0.0 0.0	0.00	30.5	24.5	0.00	0.0	0.0 0.0	27.3
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	27.2	0.00	0.0	0.0 0.0 0.0	33.1
Intersection Delay			79.5	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	356		372		317	279	326	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	2 0	0 0	0 2 0	0 0	2 0	0 0
SL	1663		1805		561	1803	1361	
LnCapacity	425		461		181	581	439	
Flow Ratio	0.2		0.2		0.6	0.2	0.2	
v/c Ratio	0.84		0.81		1.75	0.48	0.74	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.889		0.932			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	8.4		8.7		7.9	5.6	7.3	
kB	0.6		0.6		0.3	0.8	0.6	
Q2	2.3		2.2		17.8	0.7	1.7	
Q Average	10.7		10.9		25.7	6.3	8.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	13.0		13.2		30.8	7.7	10.9	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.5	
BOQ	15.4		15.6		36.0	9.4	12.9	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.5	1.6	1.6	
BOQ	16.7		16.9		38.6	10.3	14.1	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.7		1.6	1.9	1.8	
BOQ	18.4		18.7		41.3	11.9	15.8	
QSRatio								
98th Percentile Output:								
fB%	1.9		1.9		1.7	2.1	2.0	
BOQ	20.1		20.4		43.9	13.4	17.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 No-Action Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	678	394	3	1	417	523	0	0	1	96	0	135
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	783	1711	0.95	0.71	38.9	D		
TR	1158	1628	0.38	0.71	5.8	A	26.7	C
Westbound								
LT	451	1843	1.02	0.24	69.8	E	179.5	F
R	383	1568	1.50	0.24	267.0	F		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.42	0.18	38.5	D		
LT	320	1801	0.00	0.18	30.4	C	19.9	B
R	952	1478	0.15	0.64	6.6	A		

Intersection Delay = 90.4 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	678	394	3	1	417	523	0	0	1	96	0	135
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	186	108	1	1	115	144	0	0	1	25	0	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	745	436			459	575		4		99	0	139
%InSharedLn										0		
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X		X				Peds		
WB	Left			P			SB	Left	P	
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds							Peds		
NB	Right						EB	Right		
SB	Right	P					WB	Right		
Green		37.0	22.0					16.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	678	394	3	1	417	523	0	0	1	96	0	135
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	745	433	3	1	458	575	0	0	4	99	0	139
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	745	436			459	575		4		99	0	139
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.980	0.980		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.865				1.000	0.850
fLT	0.950	1.000		0.999			1.000			0.755	1.000	
Sec.	0.148											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1711	1628		1843	1568		1844			1313	1801	1478
Sec.	267											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		703	1711	# 0.41	0.411	703	1.00
Perm		42	267	0.16	0.300	80	0.52
Left	L	745			0.71	783	0.95
Prot							
Perm							
Thru	TR	436	1628	0.27	0.71	1158	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	459	1843	0.25	0.24	451	1.02
Right	R	575	1568	# 0.37	0.24	383	1.50
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	99	1313	# 0.08	0.18	233	0.42
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	139	1478	0.09	0.64	952	0.15

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.85$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.02$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.95	0.71	20.8	1.000	783	0.50	18.1	0.0	38.9	D		
TR	0.38	0.71	5.1	1.000	1158	0.50	0.7	0.0	5.8	A	26.7	C
Westbound												
LT	1.02	0.24	34.0	1.000	451	0.50	35.8	0.0	69.8	E	179.5	F
R	1.50	0.24	34.0	1.000	383	0.50	233.0	0.0	267.0	F		
Northbound												
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C
Southbound												
L	0.42	0.18	32.9	1.000	233	0.50	5.6	0.0	38.5	D		
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	19.9	B

R 0.15 0.64 6.3 1.000 952 0.50 0.3 0.0 6.6 A

Intersection delay = 90.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	745			99
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	459			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.63			2.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.48			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	23.28			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	3.72			16.00
n=Max(gq-gf)/2,0)	11.64			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.01			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	11.50			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	23.28			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gfgq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	436	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.90	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		2.16	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdifff=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		436		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.007
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	745			
v/c ratio from Capacity Worksheet, X	0.95			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	19.28			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	29.7			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.46			
XPerm	2.63			
XProt	0.79			
Case	3			
Queue at beginning of green arrow, Qa	9.14			
Queue at beginning of unsaturated green, Qu	3.99			
Residual queue, Qr	2.98			
Uniform Delay, d1	20.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		20.8	0.00	0.0	0.0	38.9
TR	0.0	0.00	13.0	5.1	0.00	0.0	0.0	5.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	34.0	0.00	2.0	0.0	69.8
R	0.0	0.00	34.0	34.0	0.00	48.0	0.0	267.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.9	0.00	0.0	0.0	38.5
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.6
Intersection Delay			90.4	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	745	436		459	575		4	99	0	139
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1102	1628		1843	1568		1844	1313	1801	1478
LnCapacity	783	1158		451	383		328	233	320	952
Flow Ratio	0.7	0.3		0.2	0.4		0.0	0.1	0.0	0.1
v/c Ratio	0.95	0.38		1.02	1.50		0.01	0.42	0.00	0.15
Grn Ratio	0.71	0.71		0.24	0.24		0.18	0.18	0.18	0.64
I Factor		0.735		0.546			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.8	4.3		11.5	14.4		0.1	2.2	0.0	1.4
kB	0.7	0.9		0.4	0.3		0.5	0.4	0.5	1.1
Q2	6.1	0.6		5.1	24.9		0.0	0.3	0.0	0.2
Q Average	14.9	4.9		16.5	39.3		0.1	2.5	0.0	1.6
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.3	1.3	1.3
BOQ	18.0	6.0		19.9	47.2		0.1	3.2	0.0	2.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4		1.7	1.6	1.7	1.6
BOQ	21.1	7.4		23.3	55.0		0.2	4.0	0.0	2.5
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5		2.0	1.8	2.0	1.9
BOQ	22.8	8.2		25.1	58.9		0.2	4.5	0.0	2.9
QSRatio										
95th Percentile Output:										
fB%	1.7	2.0		1.6	1.6		2.6	2.2	2.6	2.3
BOQ	24.6	9.6		27.1	62.9		0.2	5.5	0.0	3.6
QSRatio										
98th Percentile Output:										
fB%	1.8	2.3		1.8	1.7		3.2	2.6	3.2	2.8
BOQ	26.5	11.0		29.0	66.8		0.3	6.5	0.0	4.3
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/2013	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2020 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	454	38	0	2	64	71	4	3	0	64	6	874
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	707	1413	0.71	0.50	23.0	C		
TR	1056	2111	0.04	0.50	11.5	B	22.1	C

LTR	1536	3071	0.09	0.50	11.9	B	11.9	B
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DefL	517	1329	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	539	1386	0.14	0.39	18.3	B	71.8	E
R	593	1524	1.06	0.39	78.5	E		

Intersection Delay = 46.3 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	454	38	0	2	64	71	4	3	0	64	6	874
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	125	10	0	1	18	20	2	1	0	18	2	243
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	499	42			131		7	5			78	627
%InSharedLn												
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0		0	0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	454	38	0	2	64	71	4	3	0	64	6	874
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	499	42	0	2	70	59	7	5	0	71	7	627
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	499	42			131		7	5			78	627
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.932				1.000		1.000	0.850	
fLT	0.669	1.000		0.954			0.706	1.000		0.773		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1413	2111		3071			1329	1881		1386	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	499	1413	# 0.35	0.50	707	0.71
Prot							
Perm							
Thru	TR	42	2111	0.02	0.50	1056	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	131	3071	0.04	0.50	1536	0.09
Right							
Northbound							
Prot							
Perm							
Left	DefL	7	1329	0.01	0.39	517	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	78	1386	0.06	0.39	539	0.14
Right	R	627	1524	# 0.41	0.39	593	1.06

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.71	0.50	17.4	1.000	707	0.50	5.6	0.0	23.0	C			
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	22.1	C	
Westbound													
LTR	0.09	0.50	11.8	1.000	1536	0.50	0.1	0.0	11.9	B	11.9	B	
Northbound													
DefL	0.01	0.39	16.9	1.000	517	0.50	0.0	0.0	16.9	B			
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.14	0.39	17.8	1.000	539	0.50	0.5	0.0	18.3	B	71.8	E	

R 1.06 0.39 27.5 1.000 593 0.50 51.0 0.0 78.5 E

Intersection delay = 46.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	499		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	131		78	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/C	12.48		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.72		1.95	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.42	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.669		0.706	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	71
Proportion of LT in LT lane group, PLT	0.000	0.015 0.000 0.910
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	42	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.78
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.52	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.75
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	131	42	78	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.015	1.000	0.910
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.450	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	17.4	0.00	0.0	0.0	23.0
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	27.5	27.5	0.00	8.5	0.0	78.5
Intersection Delay			46.3	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	499	42			68		7	5		78	627	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1413	2111			1612		1329	1881		1386	1524	
LnCapacity	707	1056			806		517	732		539	593	
Flow Ratio	0.4	0.0			0.0		0.0	0.0		0.1	0.4	
v/c Ratio	0.71	0.04			0.08		0.01	0.01		0.14	1.06	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	9.6	0.5			0.9		0.1	0.1		1.3	15.7	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	1.9	0.0			0.1		0.0	0.0		0.1	9.9	
Q Average	11.6	0.6			1.0		0.1	0.1		1.4	25.5	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	14.0	0.8			1.3		0.2	0.1		1.8	30.6	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	16.5	1.0			1.6		0.2	0.1		2.2	35.8	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	17.9	1.1			1.9		0.2	0.2		2.6	38.4	
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.4		2.6	2.6		2.4	1.6	
BOQ	19.6	1.5			2.4		0.3	0.2		3.2	41.0	
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			2.9		3.2	3.2		2.8	1.7	
BOQ	21.4	1.8			2.9		0.4	0.3		3.9	43.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	173		25				4	226			614	420
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0					31.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.37	0.32	17.7	B	17.4	B
R	465	1468	0.05	0.32	14.4	B		
Westbound								

Northbound

LT 1657 3208 0.15 0.52 7.8 A 7.8 A

Southbound

TR 1950 3775 0.66 0.52 11.9 B 11.9 B

Intersection Delay = 12.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	173		25				4	226		614	420	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	49		7				1	63		192	131	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	197		22					255			1292	
%InSharedLn												
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.406	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975						0.998			0.686	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	173		25				4	226		614	420	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	197		22				4	251		767	525	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	197		22					255			1292	
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.406	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.909	0.909			0.962		0.980	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.939	
fLT	0.950				0.938		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1696	1468			3208		3775	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	197	1696	# 0.12	0.32	537	0.37
Prot							
Perm							
Thru							
Right	R	22	1468	0.01	0.32	465	0.05
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	255	3208	0.08	0.52	1657	0.15
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1292	3775	# 0.34	0.52	1950	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.46
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.55

Control Delay and LOS Determination															
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach				
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS			
Eastbound															
L	0.37	0.32	15.8	1.000	537	0.50	1.9	0.0	17.7	B	17.4	B			
R	0.05	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B					
Westbound															
Northbound															
LT	0.15	0.52	7.6	1.000	1657	0.50	0.2	0.0	7.8	A	7.8	A			
Southbound															
TR	0.66	0.52	10.7	1.000	1950	0.50	1.2	0.0	11.9	B	11.9	B			

Intersection delay = 12.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.016 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1292
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.31
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	12.55
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	5.24
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			12.55	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.405	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1292	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.016	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.406
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.8	0.00	0.0	0.0	17.7
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.6	0.00	0.0	0.0	7.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	10.7	0.00	0.0	0.0	11.9
	0.0						0.0	
Intersection Delay			12.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	197	22				133		678	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1696	1468				1684		1982	
LnCapacity	537	465				870		1024	
Flow Ratio	0.1	0.0				0.1		0.3	
v/c Ratio	0.37	0.05				0.15		0.66	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	2.5	0.3				1.2		8.3	
kB	0.5	0.5				0.8		0.6	
Q2	0.3	0.0				0.1		1.1	
Q Average	2.9	0.3				1.3		9.4	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	3.6	0.4				1.7		11.5	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.4	
BOQ	4.5	0.5				2.1		13.7	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	5.1	0.5				2.5		14.9	
QSRatio									
95th Percentile Output:									
fB%	2.2	2.5				2.4		1.8	
BOQ	6.2	0.7				3.1		16.5	
QSRatio									
98th Percentile Output:									
fB%	2.5	3.1				2.9		1.9	
BOQ	7.3	0.9				3.7		18.2	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		561	1		1			23	473	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	612	1468	0.48	0.42	15.5	B		
LT	587	1408	0.50	0.42	15.9	B	15.7	B

Northbound

L	265	635	0.00	0.42	10.2	B	10.2	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2039	4894	0.30	0.42	12.1	B	12.1	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		561	1		1			23	473	0
% Heavy Veh	1	1		1	1		1			2	2	2
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol	1	0		148	1		1			7	148	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			296	296		1			620		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.998		1.000				0.047	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.989		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		561	1		1			23	473	0
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	4	0		591	1		1			29	591	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			296	296		1			620		
Prop LTs	0.000			1.000 0.998			1.000			0.047		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.724		0.361		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1468 1408		635		4894	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	296	1468	0.20	0.42	612	0.48
Prot							
Perm							
Thru	LT	296	1408	# 0.21	0.42	587	0.50
Right							
Northbound							
Prot							
Perm							
Left	L	1	635	0.00	0.42	265	0.00
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	620	4894	# 0.13	0.42	2039	0.30
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.48	0.42	12.8	1.000	612	0.50	2.7	0.0	15.5	B		
LT	0.50	0.42	12.9	1.000	587	0.50	3.0	0.0	15.9	B	15.7	B
Northbound												
L	0.00	0.42	10.2	1.000	265	0.50	0.0	0.0	10.2	B	10.2	B
Southbound												
LTR	0.30	0.42	11.7	1.000	2039	0.50	0.4	0.0	12.1	B	12.1	B

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		296	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.05	
Adjusted opposing flow rate, Vo (veh/h)		4	620	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.93	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.79	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	2.71	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	22.29	
n=Max(gq-gf)/2,0)		0.00	1.35	
PTHo=1-PLTo		1.00	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.47	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.34	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	2.71	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.36	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.361	

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	295		
Proportion of LT in LT lane group, PLT	0.000	0.998	0.047
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.92		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.724	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		296	296	1		227	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1468	1408	635		1796	
LnCapacity	784		612	587	265		748	
Flow Ratio	0.0		0.2	0.2	0.0		0.1	
v/c Ratio	0.01		0.48	0.50	0.00		0.30	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.983		0.989	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.6	3.6	0.0		2.5	
kB	0.7		0.6	0.6	0.3		0.7	
Q2	0.0		0.6	0.6	0.0		0.3	
Q Average	0.0		4.2	4.2	0.0		2.8	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.3	
BOQ	0.1		5.2	5.3	0.0		3.6	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.6	
BOQ	0.1		6.4	6.5	0.0		4.4	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.8	
BOQ	0.1		7.1	7.2	0.0		5.0	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.0	2.0	2.6		2.2	
BOQ	0.1		8.5	8.6	0.0		6.1	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.3	3.2		2.6	
BOQ	0.1		9.8	9.9	0.0		7.2	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	24
Peak-Hour Factor, PHF	0.55
Hourly Flow Rate, HFR	43
Percent Heavy Vehicles	-- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	398
Peak Hour Factor, PHF	0.90
Hourly Flow Rate, HFR	442
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	442
C(m) (vph)	1030
v/c	0.43
95% queue length	2.19
Control Delay	11.1
LOS	B
Approach Delay	11.1
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		24				
Peak-Hour Factor, PHF		0.55				
Peak-15 Minute Volume		11				
Hourly Flow Rate, HFR		43				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			398			
Peak Hour Factor, PHF			0.90			
Peak-15 Minute Volume			111			
Hourly Flow Rate, HFR			442			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					43			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
s
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	43	
Potential Capacity	1030	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1030	
Probability of Queue free St.	0.57	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.57
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.57
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			442			
Movement Capacity (vph)			1030			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1030			
Volume			442			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					442			
C(m) (vph)					1030			
v/c					0.43			
95% queue length					2.19			
Control Delay					11.1			
LOS					B			
Approach Delay				11.1				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	54	31	165	59	0	0	0	0	31	78	20
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.86		0.77				0.80 0.80	
Flow Rate	98		290				86 72	
% Heavy Veh	17		4				1 1	
No. Lanes	1		1				2	
Opposing-Lanes	1		1				0	
Conflicting-lanes	2		2				1	
Geometry group	2		2				1	
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	98		290				86 72	
Left-Turn	0		214				38 0	
Right-Turn	36		0				0 24	
Prop. Left-Turns	0.0		0.7				0.4 0.0	
Prop. Right-Turns	0.4		0.0				0.0 0.3	
Prop. Heavy Vehicle	0.2		0.0				0.0 0.0	
Geometry Group	2		2				1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2				0.2	

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	40	46	0	0	181	23	42	63	88	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	99		264		82		136	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	99		264		82	136		
Left-Turn	46		0		47	0		
Right-Turn	0		29		0	100		
Prop. Left-Turns	0.5		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	149	160	113	2	39	5	523	39	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	560	1599	0.61	0.35	20.9	C	19.7	B
R	560	1599	0.12	0.35	13.7	B		

Westbound

LTR	531	1517	0.09	0.35	13.4	B	13.4	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2287	4732	0.25	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 13.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	160	113	2	39	5	523	39	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	41	44	31	1	10	2	135	10	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		340	67		48			581				
%InSharedLn												
Prop LTs		0.482			0.042			0.928				
Prop RTs		0.000	1.000		0.104			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	160	113	2	39	5	523	39	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	164	176	67	2	41	5	539	40	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	340 67			48			581					
Prop LTs	0.482			0.042			0.928					
Prop RTs	0.000 1.000			0.104			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.952			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.986			0.999	
fLT	0.822			0.988			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1599	1599		1517			4732	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	340	1599	# 0.21	0.35	560	0.61
Right	R	67	1599	0.04	0.35	560	0.12
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	48	1517	0.03	0.35	531	0.09
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	581	4732	# 0.12	0.48	2287	0.25
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
LT	0.61	0.35	16.1	1.000	560	0.50	4.8	0.0	20.9	C	19.7	B
R	0.12	0.35	13.2	1.000	560	0.50	0.4	0.0	13.7	B		
Westbound												
LTR	0.09	0.35	13.1	1.000	531	0.50	0.3	0.0	13.4	B	13.4	B
Northbound												
LTR	0.25	0.48	9.1	1.000	2287	0.50	0.3	0.0	9.4	A	9.4	A
Southbound												

Intersection delay = 13.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo 1.000 1.000 0.908

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho*n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 60.0 sec

Total actual green time for LT lane group, G (s) 21.0 21.0

Effective permitted green time for LT lane group, g(s) 21.0 21.0

Opposing effective green time, go (s) 21.0 21.0

Number of lanes in LT lane group, N 1 1

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	164	2	
Proportion of LT in LT lane group, PLT	0.482	0.042	0.928
Proportion of LT in opposing flow, PLTo	0.04	0.48	
Adjusted opposing flow rate, Vo (veh/h)	48	340	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.80	5.67	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	6.74	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.96	0.52	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.48	0.04	
EL1 (refer to Exhibit C16-3)	1.45	1.96	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.822	0.988	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	6.74		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.321		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	48	340	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.482	0.042	0.928	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.104	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	16.1	0.00	0.0	0.0	20.9
R	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.1	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			13.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	340	67	48		213			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1599	1599	1517		1737			
LnCapacity	560	560	531		839			
Flow Ratio	0.2	0.0	0.0		0.1			
v/c Ratio	0.61	0.12	0.09		0.25			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.999		0.999		0.980			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	4.7	0.8	0.5		2.1			
kB	0.6	0.6	0.6		0.7			
Q2	0.9	0.1	0.1		0.3			
Q Average	5.5	0.8	0.6		2.3			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.3			
BOQ	6.8	1.1	0.8		3.0			
QSRatio								
85th Percentile Output:								
fB%	1.5	1.7	1.7		1.6			
BOQ	8.3	1.4	1.0		3.7			
QSRatio								
90th Percentile Output:								
fB%	1.7	1.9	1.9		1.8			
BOQ	9.2	1.6	1.2		4.2			
QSRatio								
95th Percentile Output:								
fB%	1.9	2.4	2.5		2.2			
BOQ	10.7	2.0	1.5		5.2			
QSRatio								
98th Percentile Output:								
fB%	2.2	3.0	3.0		2.6			
BOQ	12.2	2.5	1.8		6.2			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	122		40				14	293		345	32	
Lane Width	16.0						14.0			16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 463 1738 0.43 0.27 21.1 C 21.1 C

Westbound

Northbound

LT 1093 1928 0.32 0.57 7.7 A 7.7 A

Southbound

TR 1173 2070 0.35 0.57 7.8 A 7.8 A

Intersection Delay = 10.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	122		40				14	293		345	32	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	38		12				4	84		95	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		200						353			414	
%InSharedLn												
Prop LTs		0.755						0.045			0.000	
Prop RTs		0.245						0.000			0.085	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	122		40				14	293		345	32	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	151		49				16	337		379	35	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		200						353			414	
Prop LTs		0.755						0.045			0.000	
Prop RTs		0.245						0.000			0.085	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.967						1.000			0.989		
fLT	0.964						0.978			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1738						1928			2070		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	200	1738	# 0.12	0.27	463	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	353	1928	0.18	0.57	1093	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	414	2070	# 0.20	0.57	1173	0.35
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.38

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.43	0.27	18.2	1.000	463	0.50	2.9	0.0	21.1	C	21.1	C
Westbound												
Northbound												
LT	0.32	0.57	6.9	1.000	1093	0.50	0.8	0.0	7.7	A	7.7	A
Southbound												
TR	0.35	0.57	7.0	1.000	1173	0.50	0.8	0.0	7.8	A	7.8	A

Intersection delay = 10.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		16	
Proportion of LT in LT lane group, PLT	0.755	0.045	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		414	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.27	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.90	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		3.87	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.62	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.11	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.978	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			3.87	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.114	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			414	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.045	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.085
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	18.2	0.00	0.0	0.0 0.0 0.0	21.1
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	6.9	0.00	0.0	0.0 0.0 0.0	7.7
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	7.0	0.00	0.0	0.0 0.0 0.0	7.8
Intersection Delay			10.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	200						353			414		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1738						1928			2070		
LnCapacity	463						1093			1173		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.43						0.32			0.35		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.8						3.1			3.7		
kB	0.5						0.9			0.9		
Q2	0.4						0.4			0.5		
Q Average	3.1						3.5			4.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	3.9						4.4			5.3		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	4.9						5.5			6.5		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.7			1.7		
BOQ	5.5						6.2			7.3		
QSRatio												
95th Percentile Output:												
fB%	2.1						2.1			2.0		
BOQ	6.7						7.4			8.6		
QSRatio												
98th Percentile Output:												
fB%	2.5						2.4			2.3		
BOQ	7.8						8.6			9.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 No-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	80		54				44	370		293	160	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	554	1663	0.28	0.33	16.0	B	16.0	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	840	1679	0.57	0.50	13.0	B	13.0	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	1010	2020	0.48	0.50	11.4	B	11.4	B
----	------	------	------	------	------	---	------	---

Intersection Delay = 12.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	80		54				44	370		293	160	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	23		16				13	106		80	44	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		156						476			482	
%InSharedLn												
Prop LTs		0.596						0.107			0.000	
Prop RTs	0.404						0.000			0.332		
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	80		54				44	370		293	160	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	93		63				51	425		322	160	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		156						476			482	
Prop LTs		0.596						0.107			0.000	
Prop RTs	0.404						0.000			0.332		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.945						1.000			0.955		
fLT	0.971						0.916			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1663						1679			2020		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	156	1663	# 0.09	0.33	554	0.28
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	476	1679	# 0.28	0.50	840	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	482	2020	0.24	0.50	1010	0.48
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.38

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.28	0.33	14.7	1.000	554	0.50	1.3	0.0	16.0	B	16.0	B
Westbound												
Northbound												
LT	0.57	0.50	10.5	1.000	840	0.50	2.5	0.0	13.0	B	13.0	B
Southbound												
TR	0.48	0.50	9.9	1.000	1010	0.50	1.5	0.0	11.4	B	11.4	B

Intersection delay = 12.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		51	
Proportion of LT in LT lane group, PLT	0.596	0.107	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		482	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.85	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		8.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		6.59	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		21.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.11	
EL1 (refer to Exhibit C16-3)		2.26	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.916	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			6.59	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.220	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		482	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.596		0.107	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.404	0.332
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.7	0.00	0.0	0.0	16.0
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	10.5	0.00	0.0	0.0	13.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	9.9	0.00	0.0	0.0	11.4
	0.0						0.0	
Intersection Delay			12.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	156						476			482		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1663						1679			2020		
LnCapacity	554						840			1010		
Flow Ratio	0.1						0.3			0.2		
v/c Ratio	0.28						0.57			0.48		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.9						5.5			5.3		
kB	0.6						0.7			0.8		
Q2	0.2						0.9			0.7		
Q Average	2.1						6.4			6.0		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.7						7.9			7.4		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.4						9.5			9.0		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.9						10.5			9.9		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	4.8						12.0			11.4		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.1		
BOQ	5.7						13.6			12.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	10		105	230	469	127	63	171		353		32
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.06	0.13	23.1	C	33.9	C
R	220	1652	0.62	0.13	34.9	C		
Westbound								
LTR	1339	4726	0.71	0.28	21.6	C	21.6	C
Northbound								
L	163	489	0.44	0.33	23.3	C		
T	593	1778	0.32	0.33	16.3	B	18.2	B
Southbound								
TR	690	2070	0.62	0.33	20.2	C	20.2	C

Intersection Delay = 21.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10		105	230	469	127	63	171		353	32	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		34	66	135	36	18	48		98	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	13		136		949		71	192			428	
%InSharedLn												
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000		0.084		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10		105	230	469	127	63	171		353	32	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	13		136	264	539	146	71	192		392	36	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	13		136		949		71	192			428	
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000			0.084	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.943	0.943	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.977	0.977		1.000	0.989	0.989
fLT	0.950		0.986	0.986	0.273	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4726	4726	489	1778	2070	2070
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	1668	0.01	0.13	222	0.06
Prot							
Perm							
Thru							
Right	R	136	1652	# 0.08	0.13	220	0.62
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	949	4726	# 0.20	0.28	1339	0.71
Right							
Northbound							
Prot							
Perm							
Left	L	71	489	0.15	0.33	163	0.44
Prot							
Perm							
Thru	T	192	1778	0.11	0.33	593	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	428	2070	# 0.21	0.33	690	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.06	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	33.9	C	
R	0.62	0.13	24.6	1.000	220	0.50	10.4	0.0	34.9	C			
Westbound													
LTR	0.71	0.28	19.3	1.000	1339	0.50	2.3	0.0	21.6	C	21.6	C	
Northbound													
L	0.44	0.33	15.6	1.000	163	0.50	7.7	0.0	23.3	C	18.2	B	
T	0.32	0.33	14.9	1.000	593	0.50	1.4	0.0	16.3	B			
Southbound													
TR	0.62	0.33	16.8	1.000	690	0.50	3.4	0.0	20.2	C	20.2	C	

Intersection delay = 21.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			71	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			428	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			1.18	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.13	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			9.37	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			10.63	
n=Max(gq-gf)/2,0)			4.68	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.95	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.273	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.278 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.37	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.468	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			428	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.154	0.084
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	24.6	0.00	0.0	0.0	34.9
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.3	0.00	0.0	0.0	21.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.6	0.00	0.0	0.0	23.3
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.8	0.00	0.0	0.0	20.2
	0.0						0.0	
Intersection Delay			21.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	13	136		348		71	192		428
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1734		489	1778		2070
LnCapacity	222	220		491		163	593		690
Flow Ratio	0.0	0.1		0.2		0.1	0.1		0.2
v/c Ratio	0.06	0.62		0.71		0.44	0.32		0.62
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	2.1		5.2		0.9	2.4		6.0
kB	0.2	0.2		0.4		0.2	0.6		0.5
Q2	0.0	0.4		0.9		0.2	0.3		0.9
Q Average	0.2	2.5		6.1		1.1	2.7		6.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.3	3.2		7.5		1.4	3.3		8.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.5
BOQ	0.3	4.0		9.1		1.8	4.2		10.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.4	4.6		10.0		2.1	4.8		11.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		1.9		2.4	2.2		1.9
BOQ	0.5	5.6		11.5		2.6	5.8		12.7
QSRatio									
98th Percentile Output:									
fB%	3.1	2.6		2.1		2.9	2.6		2.1
BOQ	0.6	6.6		13.0		3.2	6.9		14.3
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	15	8				6	228	116	228	431	28
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 454 1604 0.10 0.28 16.3 B 16.3 B

Westbound

Northbound

LTR 920 1672 0.43 0.55 9.3 A 9.3 A

Southbound

L 547 995 0.46 0.55 10.4 B
 TR 1017 1849 0.50 0.55 9.8 A 10.0- A

Intersection Delay = 10.0- (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	15	8				6	228	116	228	431	28
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	64	33	63	120	8
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		45						393		253	510	
%InSharedLn												
Prop LTs		0.178						0.018		1.000	0.000	
Prop RTs		0.289						0.331			0.061	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	15	8				6	228	116	228	431	28
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	8	24	13				7	256	130	253	479	31
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	45						393			253	510	
Prop LTs	0.178						0.018			1.000	0.000	
Prop RTs	0.289						0.331			0.061		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW	1.033							1.133			1.000	1.000
fHV	0.980							0.943			0.990	0.990
fG	1.000							1.000			1.000	1.000
fP	0.875							0.875			1.000	1.000
fBB	1.000							0.992			1.000	0.992
fA	1.000							1.000			1.000	1.000
fLU	1.000							1.000			1.000	1.000
fRT	0.961							0.955				0.991
fLT	0.991							0.993			0.529	1.000
Sec.												
fLpb	1.000							1.000			1.000	1.000
fRpb	1.000							1.000				1.000
S	1604							1672			995	1849
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	45	1604	# 0.03	0.28	454	0.10
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	393	1672	0.24	0.55	920	0.43
Right							
Southbound							
Prot							
Perm							
Left	L	253	995	0.25	0.55	547	0.46
Prot							
Perm							
Thru	TR	510	1849	# 0.28	0.55	1017	0.50
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.30$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.36$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.10	0.28	15.9	1.000	454	0.50	0.4	0.0	16.3	B	16.3	B
Westbound												
Northbound												
LTR	0.43	0.55	7.9	1.000	920	0.50	1.4	0.0	9.3	A	9.3	A
Southbound												
L	0.46	0.55	8.1	1.000	547	0.50	2.2	0.0	10.4	B		
TR	0.50	0.55	8.4	1.000	1017	0.50	1.4	0.0	9.8	A	10.0-	A

Intersection delay = 10.0- (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				253
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				393
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.22
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.55
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.87
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.13
n=Max(gq-gf)/2,0)				1.94
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.89
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.92
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.87
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.53
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.529

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		7	
Proportion of LT in LT lane group, PLT	0.178	0.018	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		510	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.12	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.50	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		5.82	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.993	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			5.82	3.87
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.176	0.117
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			510	393
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.018	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.289	0.331	0.061
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.9	0.00	0.0	0.0	9.3
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.1	0.00	0.0	0.0	10.4
TR	0.0	0.00	13.5	8.4	0.00	0.0	0.0	9.8
	0.0						0.0	

Intersection Delay	10.0-	sec/veh	Intersection LOS	A
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		45						393			253	510
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1604						1672			995	1849
LnCapacity		454						920			547	1017
Flow Ratio		0.0						0.2			0.3	0.3
v/c Ratio		0.10						0.43			0.46	0.50
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.932				0.785
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.6						3.9			2.5	5.3
kB		0.5						0.8			0.4	0.7
Q2		0.1						0.6			0.4	0.7
Q Average		0.6						4.4			2.9	6.0
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.3	1.2
BOQ		0.8						5.5			3.7	7.3
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.6	1.5
BOQ		1.0						6.7			4.6	8.9
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.8	1.7
BOQ		1.2						7.5			5.2	9.8
QSRatio												
95th Percentile Output:												
fB%		2.5						2.0			2.2	1.9
BOQ		1.5						8.9			6.3	11.3
QSRatio												
98th Percentile Output:												
fB%		3.0						2.3			2.5	2.2
BOQ		1.8						10.2			7.4	12.8
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	5	8	17	265	26	105	21	240	170	90	329	19
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 628 1413 0.06 0.44 14.5 B 14.5 B

Westbound

L 547 1231 0.58 0.44 22.3 C
 T 763 1717 0.04 0.44 14.2 B 20.1 C
 R 563 1266 0.22 0.44 16.2 B

Northbound

LTR 688 1549 0.70 0.44 24.2 C 24.2 C

Southbound

LTR 631 1419 0.77 0.44 27.1 C 27.1 C

Intersection Delay = 23.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	8	17	265	26	105	21	240	170	90	329	19
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	3	5	79	8	31	6	67	48	25	91	5
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		38		315	31	125		485			487	
%InSharedLn												
Prop LTs		0.158		1.000	0.000			0.049			0.205	
Prop RTs		0.579			0.000	1.000		0.394			0.043	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.830			0.650			0.650	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	8	17	265	26	105	21	240	170	90	329	19
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	10	22	315	31	125	24	270	191	100	366	21
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	38			315	31	125	485			487		
Prop LTs	0.158			1.000	0.000		0.049			0.205		
Prop RTs	0.579			0.000 1.000			0.394			0.043		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.935	0.935	0.935	0.943		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.922		1.000 0.850			0.947		0.994		
fLT	0.980		0.732	1.000		0.965		0.770		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.995		
fRpb	0.968		1.000 1.000			0.978		1.000		
S	1413		1231	1717	1266	1549		1419		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	38	1413	0.03	0.44	628	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	315	1231	# 0.26	0.44	547	0.58
Prot							
Perm							
Thru	T	31	1717	0.02	0.44	763	0.04
Right	R	125	1266	0.10	0.44	563	0.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	485	1549	0.31	0.44	688	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	487	1419	# 0.34	0.44	631	0.77
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.60$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.67$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	628	0.50	0.2	0.0	14.5	B	14.5	B
Westbound												
L	0.58	0.44	18.7	1.000	547	0.50	3.6	0.0	22.3	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	20.1	C
R	0.22	0.44	15.4	1.000	563	0.50	0.8	0.0	16.2	B		
Northbound												
LTR	0.70	0.44	20.2	1.000	688	0.50	3.9	0.0	24.2	C	24.2	C
Southbound												
LTR	0.77	0.44	21.1	1.000	631	0.50	5.9	0.0	27.1	C	27.1	C

Intersection delay = 23.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		315		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		38		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.95		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.732		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	6	24	100	
Proportion of LT in LT lane group, PLT	0.158	0.000	0.049	0.205
Proportion of LT in opposing flow, PLTo	0.00	0.21	0.05	
Adjusted opposing flow rate, Vo (veh/h)	31	487	485	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.15	0.60	2.50	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	12.18	12.13	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	16.4	3.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	12.79	12.74	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	23.56	27.26	
n=Max(gq-gf)/2,0)	0.00	0.00	4.54	
PTHo=1-PLTo	1.00	0.79	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.05	0.21	
EL1 (refer to Exhibit C16-3)	1.42	2.27	2.27	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.16	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06	
gdifff=max(gq-gf,0)	0.00	0.00	9.08	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.77	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.980	0.965	0.770	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	12.79	12.74
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.320	0.318
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	31	38	487	485
OCCr	0.000	0.053	0.000	0.024
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.976
Proportion of left turns, PLT	0.158	1.000	0.049	0.205
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.995
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.579	1.000	0.394	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.968	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.5
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.7	0.00	0.0	0.0	22.3
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.4	0.00	0.0	0.0	16.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.2	0.00	0.0	0.0	24.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.1	0.00	0.0	0.0	27.1
	0.0						0.0	
Intersection Delay			23.6	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	38		315	31	125	485		487	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1413		1231	1717	1266	1549		1419	
LnCapacity	628		547	763	563	688		631	
Flow Ratio	0.0		0.3	0.0	0.1	0.3		0.3	
v/c Ratio	0.06		0.58	0.04	0.22	0.70		0.77	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.830			0.650		0.650	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.5		5.9	0.4	1.9	9.8		10.3	
kB	0.8		0.6	0.8	0.6	0.6		0.5	
Q2	0.1		0.8	0.0	0.2	1.3		1.7	
Q Average	0.6		6.7	0.5	2.1	11.1		12.0	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	0.8		8.2	0.6	2.7	13.5		14.5	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	1.0		9.9	0.8	3.4	15.9		17.1	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.6		1.5	
BOQ	1.2		10.9	0.9	3.9	17.3		18.5	
QSRatio									
95th Percentile Output:									
fB%	2.5		1.9	2.5	2.3	1.7		1.7	
BOQ	1.5		12.5	1.2	4.8	19.0		20.2	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.9		1.8	
BOQ	1.8		14.0	1.4	5.7	20.7		22.0	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	166		188	110	191		191		103			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR 916 1831 0.38 0.50 15.0 B 15.0 B

Westbound

LT 638 1276 0.52 0.50 18.2 B 18.2 B

Northbound

LR 565 1454 0.59 0.39 26.0 C 26.0 C

Southbound

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		166	188	110	191		191		103			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		46	52	30	52		54		29			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		344			331			334				
%InSharedLn												
Prop LTs		0.000			0.366			0.650				
Prop RTs		0.465			0.000			0.350				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		166	188	110	191		191		103			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		184	160	121	210		217		117			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		344			331			334				
Prop LTs		0.000			0.366			0.650				
Prop RTs		0.465			0.000			0.350				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.937			1.000			0.953					
fLT	1.000			0.687			0.969					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1831			1276			1454					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 19.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	121		
Proportion of LT in LT lane group, PLT	0.000	0.366	0.650
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		344	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		3.03	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.60	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		3.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		7.21	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		37.79	
n=Max(gq-gf)/2,0)		2.10	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.37	
EL1 (refer to Exhibit C16-3)		1.97	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.69	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.687	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
TR	0.0						0.0	
	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.0
	0.0						0.0	
Westbound								
LT	0.0						0.0	
	0.0	0.00	22.5	15.2	0.00	0.0	0.0	18.2
	0.0						0.0	
Northbound								
LR	0.0						0.0	
	0.0	0.00	27.5	21.8	0.00	0.0	0.0	26.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			19.7	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		344			331			334				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1831			1276			1454				
LnCapacity		916			638			565				
Flow Ratio		0.2			0.3			0.2				
v/c Ratio		0.38			0.52			0.59				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.3			5.6			6.6				
kB		1.0			0.8			0.7				
Q2		0.6			0.9			1.0				
Q Average		5.9			6.5			7.6				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		7.3			7.9			9.3				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		8.8			9.6			11.2				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.6			1.6				
BOQ		9.8			10.6			12.3				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.9			1.8				
BOQ		11.3			12.1			13.8				
QSRatio												
98th Percentile Output:												
fB%		2.2			2.1			2.0				
BOQ		12.8			13.6			15.4				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	34	18	29	57	17	34	29	235	68	58	237	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 230 1968 0.41 0.12 30.0 C 30.0 C

Westbound

LTR 497 1989 0.27 0.25 19.4 B 19.4 B

Northbound

LTR 708 1848 0.54 0.38 17.3 B 17.3 B

Southbound

LTR 651 1697 0.61 0.38 19.2 B 19.2 B

Intersection Delay = 19.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	34	18	29	57	17	34	29	235	68	58	237	28
% Heavy Veh	2	2	2	1	1	1	6	6	6	9	9	9
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
PK 15 Vol	10	5	8	18	5	10	8	68	20	18	73	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		95			133			381			400	
%InSharedLn												
Prop LTs		0.421			0.526			0.087			0.180	
Prop RTs		0.358			0.316			0.205			0.087	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	34	18	29	57	17	34	29	235	68	58	237	28
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
Adj flow	40	21	34	70	21	42	33	270	78	72	293	35
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	95			133			381			400		
Prop LTs	0.421			0.526			0.087			0.180		
Prop RTs	0.358			0.316			0.205			0.087		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.980			0.990			0.943			0.917		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.952			0.957			0.972			0.988		
fLT	0.979			0.974			0.943			0.876		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1968			1989			1848			1697		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	95	1968	# 0.05	0.12	230	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	133	1989	# 0.07	0.25	497	0.27
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	381	1848	0.21	0.38	708	0.54
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	400	1697	# 0.24	0.38	651	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.41	0.12	24.6	1.000	230	0.50	5.4	0.0	30.0	C	30.0	C	
Westbound													
LTR	0.27	0.25	18.1	1.000	497	0.50	1.3	0.0	19.4	B	19.4	B	
Northbound													
LTR	0.54	0.38	14.4	1.000	708	0.50	2.9	0.0	17.3	B	17.3	B	
Southbound													
LTR	0.61	0.38	14.9	1.000	651	0.50	4.3	0.0	19.2	B	19.2	B	

Intersection delay = 19.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	72
Proportion of LT in LT lane group, PLT	0.421	0.526	0.087	0.180
Proportion of LT in opposing flow, PLTo			0.18	0.09
Adjusted opposing flow rate, Vo (veh/h)			400	381
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	1.20
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.67	6.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	3.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			7.56	7.10
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.26	15.90
n=Max(gq-gf)/2,0)			0.00	1.67
PTHo=1-PLTo			0.82	0.91
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.09	0.18
EL1 (refer to Exhibit C16-3)			2.08	2.04
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.62
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			0.00	3.34
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.943	0.876

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.10
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.309
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				381
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.180
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.358	0.205
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	30.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.1	0.00	0.0	0.0	19.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.4	0.00	0.0	0.0	17.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.9	0.00	0.0	0.0	19.2
	0.0						0.0	
Intersection Delay			19.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	95		133		381		400	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	1 0	0 0	1 0	0 0	1 0	0 0
SL	1968		1989		1848		1697	
LnCapacity	230		497		708		651	
Flow Ratio	0.0		0.1		0.2		0.2	
v/c Ratio	0.41		0.27		0.54		0.61	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.5		1.8		4.9		5.4	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.2		0.8		1.0	
Q Average	1.7		2.0		5.7		6.4	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.1		2.5		7.0		7.8	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.7		3.2		8.5		9.4	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.8		1.7		1.6	
BOQ	3.1		3.6		9.5		10.4	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.3		1.9		1.9	
BOQ	3.9		4.5		11.0		12.0	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.7		2.2		2.1	
BOQ	4.7		5.3		12.4		13.5	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		306	18			14	309	
Peak-Hour Factor, PHF		0.87	0.87			0.81	0.81	
Hourly Flow Rate, HFR		351	20			17	381	
Percent Heavy Vehicles		--	--			7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		29		27				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		42		39				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1		4	7	8	9		10	11	12
Lane Config			LT		LR					
v (vph)			17		81					
C(m) (vph)			1160		458					
v/c			0.01		0.18					
95% queue length			0.04		0.64					
Control Delay			8.1		14.5					
LOS			A		B					
Approach Delay					14.5					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		306	18	14	309	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		88	5	4	95	
Hourly Flow Rate, HFR		351	20	17	381	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	29		27			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	11		10			
Hourly Flow Rate, HFR	42		39			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		381
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		371	776		361			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	361	
Potential Capacity	672	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	672	
Probability of Queue free St.	0.94	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	371	
Potential Capacity	1160	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1160	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	776	
Potential Capacity	359	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.93
Movement Capacity	354	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 776
Potential Capacity 359
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.93
Movement Capacity 354

Results for Two-stage process:

a
y
C t 354

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	42		39			
Movement Capacity (vph)	354		672			
Shared Lane Capacity (vph)		458				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	354		672			
Volume	42		39			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		458				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		17		81				
C(m) (vph)		1160		458				
v/c		0.01		0.18				
95% queue length		0.04		0.64				
Control Delay		8.1		14.5				
LOS		A		B				
Approach Delay				14.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		381
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	11	2	354	20	269	4	141	338	211	245	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1742	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	529	1269	0.86	0.42	31.7	C	26.4	C
R	523	1256	0.63	0.42	19.1	B		

Northbound

LTR	739	1774	0.70	0.42	19.5	B	19.5	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	437	1048	1.22	0.42	133.7	F	133.7	F
-----	-----	------	------	------	-------	---	-------	---

Intersection Delay = 55.1 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	354	20	269	4	141	338	211	245	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	108	6	82	1	38	91	61	71	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			456	328		519			531	
%InSharedLn												
Prop LTs		0.063			0.947			0.008			0.461	
Prop RTs		0.125			0.000	1.000		0.699			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	354	20	269	4	141	338	211	245	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	432	24	328	4	152	363	245	285	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			456 328			519			531		
Prop LTs	0.063			0.947			0.008			0.461		
Prop RTs	0.125			0.000 1.000			0.699			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.983			1.000 0.850			0.906			1.000		
fLT	0.983			0.726			0.996			0.525		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1742			1269 1256			1774			1048		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1742	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	456	1269	# 0.36	0.42	529	0.86
Right	R	328	1256	0.26	0.42	523	0.63
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	519	1774	0.29	0.42	739	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	531	1048	# 0.51	0.42	437	1.22
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.87
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.86	0.42	15.9	1.000	529	0.50	15.8	0.0	31.7	C	26.4	C
R	0.63	0.42	13.8	1.000	523	0.50	5.2	0.0	19.1	B		
Northbound												
LTR	0.70	0.42	14.4	1.000	739	0.50	5.1	0.0	19.5	B	19.5	B
Southbound												
LTR	1.22	0.42	17.5	1.000	437	0.50	116.2	0.0	133.7	F	133.7	F

Intersection delay = 55.1 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	432	4	245
Proportion of LT in LT lane group, PLT	0.063	0.947	0.008	0.461
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.46	0.01
Adjusted opposing flow rate, Vo (veh/h)	456	16	531	519
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.20	0.07	4.08
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.60	0.27	8.85	8.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.09	0.00	9.70	9.44
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	15.56
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.72
PTHo=1-PLTo	0.05	0.94	0.54	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.01	0.46
EL1 (refer to Exhibit C16-3)	2.20	1.40	2.37	2.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.65
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	9.44
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.52
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.983	0.726	0.996	0.525

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.09		9.70	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.323		0.388	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	456		531	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.9	0.00	0.0	0.0	31.7
R	0.0	0.00	17.5	13.8	0.00	0.0	0.0	19.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.4	0.00	0.0	0.0	19.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	23.5	0.0	133.7
	0.0						0.0	
Intersection Delay			55.1	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	16			456	328	519		531	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1742			1269	1256	1774		1048	
LnCapacity	726			529	523	739		437	
Flow Ratio	0.0			0.4	0.3	0.3		0.5	
v/c Ratio	0.02			0.86	0.63	0.70		1.22	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.933		0.919		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.2			6.9	4.3	7.1		8.9	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			2.5	0.8	1.4		14.0	
Q Average	0.2			9.4	5.1	8.6		22.9	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.2			11.5	6.4	10.4		27.5	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.4	1.5	1.5		1.4	
BOQ	0.3			13.6	7.8	12.5		32.1	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.6	1.7	1.6		1.5	
BOQ	0.3			14.9	8.6	13.6		34.4	
QSRatio									
95th Percentile Output:									
fB%	2.6			1.8	2.0	1.8		1.6	
BOQ	0.4			16.5	10.1	15.3		36.8	
QSRatio									
98th Percentile Output:									
fB%	3.1			1.9	2.2	2.0		1.7	
BOQ	0.5			18.2	11.5	16.9		39.2	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				462		4		479			601	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.83 0.33 23.0 C 23.0 C

Northbound

T 1026 2051 0.50 0.50 11.6 B 11.6 B

Southbound

T 954 1907 0.73 0.50 13.6 B 13.6 B

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				462		4	479			601		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				138		1	129			175		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					555		515			699		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				462		4	479			601		
PHF				0.84		0.84	0.93			0.86		
Adj flow				550		5	515			699		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					555			515			699	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
fLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	555	2009	# 0.28	0.33	670	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	515	2051	0.25	0.50	1026	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	699	1907	# 0.37	0.50	954	0.73
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.64

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.83	0.33	18.4	1.000	670	0.50	4.6	0.0	23.0	C	23.0	C	
Northbound													
T	0.50	0.50	10.0	1.000	1026	0.50	1.6	0.0	11.6	B	11.6	B	
Southbound													
T	0.73	0.50	11.8	1.000	954	0.50	1.7	0.0	13.6	B	13.6	B	

Intersection delay = 16.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.4	0.00	0.0	0.0	23.0
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.0	0.00	0.0	0.0	11.6
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.8	0.00	0.0	0.0	13.6
	0.0						0.0	
Intersection Delay			16.0	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			479	262		188	875	
Peak-Hour Factor, PHF			0.93	0.93		0.86	0.86	
Hourly Flow Rate, HFR			515	281		218	1017	
Percent Heavy Vehicles			--	--		18	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration			TR			LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/			/
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		218						
C(m) (vph)		759						
v/c		0.29						
95% queue length		1.19						
Control Delay		11.6						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		479	262	188	875	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		129	70	55	254	
Hourly Flow Rate, HFR		515	281	218	1017	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		1017
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		796						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	796	
Potential Capacity	759	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	759	
Probability of Queue free St.	0.71	1.00
Maj L-Shared Prob Q free St.	0.29	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.29	0.29
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.71	0.71
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		218						
C(m) (vph)		759						
v/c		0.29						
95% queue length		1.19						
Control Delay		11.6						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.71
v(i1), Volume for stream 2 or 5		1017
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.29
d(M,LT), Delay for stream 1 or 4		11.6
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		8.3

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				134		174	554	105		147	713	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 397 1488 0.92 0.27 49.0 D 49.0 D

Northbound

TR 1096 1935 0.65 0.57 11.3 B 11.3 B

Southbound

LT 685 1208 1.46 0.57 220.9 F 220.9 F

Intersection Delay = 118.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				134		174	554	105		147	713	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				40		52	149	28		43	207	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					367			709			1000	
%InSharedLn												
Prop LTs					0.436			0.000			0.171	
Prop RTs					0.564			0.159			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				134		174	554	105		147	713	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				160		207	596	113		171	829	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					367			709			1000	
Prop LTs					0.436			0.000			0.171	
Prop RTs					0.564			0.159			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.924			0.978			1.000	
fLT					0.979			1.000			0.618	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1488			1935			1208	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	367	1488	# 0.25	0.27	397	0.92
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	709	1935	0.37	0.57	1096	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1000	1208	# 0.83	0.57	685	1.46
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.07
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.29

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.92	0.27	21.4	1.000	397	0.50	27.6	0.0	49.0	D	49.0	D
Northbound												
TR	0.65	0.57	8.9	1.000	1096	0.50	2.4	0.0	11.3	B	11.3	B
Southbound												
LT	1.46	0.57	13.0	1.000	685	0.50	207.9	0.0	220.9	F	220.9	F

Intersection delay = 118.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			171
Proportion of LT in LT lane group, PLT	0.436	0.000	0.171
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			709
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.82
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.36
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.64
n=Max(gq-gf)/2,0)			3.46
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.17
EL1 (refer to Exhibit C16-3)			2.82
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.62
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.618

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.36
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.246
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				709
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.171
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.564	0.159
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.4	0.00	0.0	0.0	49.0
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.9	0.00	0.0	0.0	11.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	78.8	0.0	220.9
	0.0						0.0	
Intersection Delay			118.9	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L TR			LTR		
Volume	96	49	130	35	195	82	86	556	109	151	529	50
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	439	1275	0.71	0.34	30.6	C	30.6	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	563	1635	0.68	0.34	31.9	C	31.9	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	272	499	0.35	0.54	14.3	B		
TR	1065	1957	0.69	0.54	17.7	B	17.3	B

Southbound

LTR	934	1716	0.89	0.54	29.8	C	29.8	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 25.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	96	49	130	35	195	82	86	556	109	151	529	50
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
PK 15 Vol	27	14	37	11	60	25	24	153	30	43	152	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		313			385		95	731			828	
%InSharedLn												
Prop LTs		0.348			0.112		1.000	0.000			0.210	
Prop RTs		0.473			0.262			0.164			0.056	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	96	49	130	35	195	82	86	556	109	151	529	50
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
Adj flow	109	56	148	43	241	101	95	611	120	174	608	46
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	313			385			95 731			828		
Prop LTs	0.348			0.112			1.000 0.000			0.210		
Prop RTs	0.473			0.262			0.164			0.056		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.936			0.965			0.975			0.992		
fLT	0.639			0.936			0.284 1.000			0.548		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1275			1635			499 1957			1716		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	313	1275	# 0.25	0.34	439	0.71
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	385	1635	0.24	0.34	563	0.68
Right							
Northbound							
Prot							
Perm							
Left	L	95	499	0.19	0.54	272	0.35
Prot							
Perm							
Thru	TR	731	1957	0.37	0.54	1065	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	828	1716	# 0.48	0.54	934	0.89
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.71	0.34	25.6	1.000	439	0.50	4.9	0.0	30.6	C	30.6	C	
Westbound													
LTR	0.68	0.34	25.3	1.000	563	0.50	6.6	0.0	31.9	C	31.9	C	
Northbound													
L	0.35	0.54	11.5	1.000	272	0.50	2.7	0.0	14.3	B			
TR	0.69	0.54	14.9	1.000	1065	0.50	2.8	0.0	17.7	B	17.3	B	
Southbound													
LTR	0.89	0.54	18.1	1.000	934	0.50	11.7	0.0	29.8	C	29.8	C	

Intersection delay = 25.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			95	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.21	
Adjusted opposing flow rate, Vo (veh/h)			828	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.38	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.87	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			8.06	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.94	
n=Max(gq-gf)/2,0)			4.03	
PTHo=1-PLTo			0.79	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.94	
EL2=Max((1-Ptho**n)/Plto, 1.0)			2.92	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			8.06	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.28	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.284	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	109	43	174
Proportion of LT in LT lane group, PLT	0.348	0.112	0.000
Proportion of LT in opposing flow, PLTo	0.11	0.35	0.00
Adjusted opposing flow rate, Vo (veh/h)	385	313	731
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	1.08	4.35
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.63	7.82	18.27
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.2	7.6	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	12.73	10.14	23.04
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.27	20.86	25.96
n=Max(gq-gf)/2,0)	5.79	1.27	11.52
PTHo=1-PLTo	0.89	0.65	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.35	0.11	0.99
EL1 (refer to Exhibit C16-3)	2.05	1.91	2.88
EL2=Max((1-Ptho**n)/Plto, 1.0)	4.44	1.20	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.08
gdifff=max(gq-gf,0)	11.57	2.54	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.94	0.19
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.639	0.936	0.548

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	12.73	10.14	8.06	23.04
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.411	0.327	0.165	0.470
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	385	313	828	731
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.348	0.112	1.000	0.210
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.473	0.262	0.164	0.056
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	25.6	0.00	0.0	0.0	30.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	25.3	0.00	0.0	0.0	31.9
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	11.5	0.00	0.0	0.0	14.3
TR	0.0	0.00	20.5	14.9	0.00	0.0	0.0	17.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	18.1	0.00	0.0	0.0	29.8
	0.0						0.0	
Intersection Delay			25.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	313		385		95	731	434	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1275		1635		499	1957	901	
LnCapacity	439		563		272	1065	490	
Flow Ratio	0.2		0.2		0.2	0.4	0.5	
v/c Ratio	0.71		0.68		0.35	0.69	0.89	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.8		8.3		1.3	13.3	9.5	
kB	0.3		0.8		0.4	0.9	0.7	
Q2	0.8		1.5		0.2	1.9	3.4	
Q Average	7.6		9.8		1.5	15.2	13.0	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	9.2		11.9		1.9	18.3	15.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.6	1.4	1.4	
BOQ	11.1		14.1		2.5	21.5	18.5	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.5	
BOQ	12.2		15.4		2.8	23.2	20.0	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.7		2.3	1.6	1.7	
BOQ	13.8		17.1		3.6	25.1	21.8	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.9		2.8	1.8	1.8	
BOQ	15.4		18.7		4.3	27.0	23.5	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	379						735			659		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	675	2025	0.62	0.33	29.4	C	29.4	C

Westbound

Northbound

T 2156 3880 0.38 0.56 11.7 B 11.7 B

Southbound

T 1990 3582 0.38 0.56 11.8 B 11.8 B

Intersection Delay = 15.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	379						735			659		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	104						204			189		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	416						817			757		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	379						735			659		
PHF	0.91						0.90			0.87		
Adj flow	416						817			757		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	416						817			757		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.990							0.990				0.990			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2025							3880				3582			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	416	2025	# 0.21	0.33	675	0.62
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	817	3880	0.21	0.56	2156	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	757	3582	# 0.21	0.56	1990	0.38
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.42$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.47$

Control Delay and LOS Determination											
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach
	v/c	g/C							Delay	LOS	Delay LOS
Eastbound											
L	0.62	0.33	25.2	1.000	675	0.50	4.2	0.0	29.4	C	29.4 C
Westbound											
Northbound											
T	0.38	0.56	11.3	1.000	2156	0.50	0.4	0.0	11.7	B	11.7 B
Southbound											
T	0.38	0.56	11.3	1.000	1990	0.50	0.5	0.0	11.8	B	11.8 B

Intersection delay = 15.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	25.2	0.00	0.0	0.0	29.4
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.3	0.00	0.0	0.0	11.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.3	0.00	0.0	0.0	11.8
	0.0						0.0	
Intersection Delay			15.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	416						429		397	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.62						0.38		0.38	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.7						6.0		5.6	
kB	0.9						1.0		1.1	
Q2	1.3						0.6		0.7	
Q Average	10.1						6.6		6.3	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	12.2						8.1		7.7	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	14.5						9.8		9.3	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.6	
BOQ	15.8						10.8		10.3	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.9		1.9	
BOQ	17.4						12.4		11.8	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.1	
BOQ	19.1						13.9		13.4	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 659
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 189
 Hourly Flow Rate, HFR 757
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 71
 Peak Hour Factor, PHF 0.78
 Peak-15 Minute Volume 23
 Hourly Flow Rate, HFR 91
 Percent Heavy Vehicles 55
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								378
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		378
Potential Capacity		566
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		566
Probability of Queue free St.	1.00	0.84
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	419
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	419
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	419	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	419	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	467
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	467

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	697	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity	585	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						91
Movement Capacity (vph)						566
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						566
Volume						91
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								91
C(m) (vph)								566
v/c								0.16
95% queue length								0.57
Control Delay								12.6
LOS								B
Approach Delay							12.6	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 No-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	108	252	201	247	500	86	109	165	150	222	59	56
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	155	464	0.79	0.33	51.9	D		
TR	591	1773	0.78	0.33	34.3	C	38.0	D
Westbound								
L	240	696	1.14	0.34	129.7	F		
TR	1142	3315	0.61	0.34	26.9	C	55.8	E
Northbound								
LTR	933	3357	0.46	0.28	28.5	C	28.5	C
Southbound								
L	384	1728	0.76	0.22	45.6	D		
TR	370	1665	0.32	0.22	31.5	C	41.6	D

Intersection Delay = 44.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	108	252	201	247	500	86	109	165	150	222	59	56
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	31	72	57	69	152	26	29	44	40	73	19	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	123	463		274	701			428		292	119	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.273			0.000	
Prop RTs		0.382			0.130			0.313			0.345	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	108	252	201	247	500	86	109	165	150	222	59	56
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	123	286	177	274	610	91	117	177	134	292	78	41
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	123	463		274	701		428			292	119	
Prop LTs	1.000	0.000		1.000	0.000		0.273			0.000		
Prop RTs		0.382			0.130		0.313				0.345	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.943			0.981		0.953				0.948	
fLT	0.255	1.000		0.409	1.000		0.987			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	464	1773		696	3315		3357			1728	1665	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	123	464	0.27	0.33	155	0.79
Prot							
Perm							
Thru	TR	463	1773	0.26	0.33	591	0.78
Right							
Westbound							
Prot							
Perm							
Left	L	274	696	# 0.39	0.34	240	1.14
Prot							
Perm							
Thru	TR	701	3315	0.21	0.34	1142	0.61
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	428	3357	# 0.13	0.28	933	0.46
Right							
Southbound							
Prot							
Perm							
Left	L	292	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	119	1665	0.07	0.22	370	0.32
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.69$
Total lost time per cycle, $L = 14.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.82$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.79	0.33	27.2	1.000	155	0.50	24.7	0.0	51.9	D		
TR	0.78	0.33	27.1	1.000	591	0.50	7.2	0.0	34.3	C	38.0	D
Westbound												
L	1.14	0.34	29.5	1.000	240	0.50	100.2	0.0	129.7	F		
TR	0.61	0.34	24.5	1.000	1142	0.50	2.3	0.0	26.9	C	55.8	E
Northbound												
LTR	0.46	0.28	26.9	1.000	933	0.50	1.6	0.0	28.5	C	28.5	C
Southbound												
L	0.76	0.22	32.8	1.000	384	0.50	12.9	0.0	45.6	D		
TR	0.32	0.22	29.3	1.000	370	0.50	2.2	0.0	31.5	C	41.6	D

Intersection delay = 44.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	123	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	701	463		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	3.08	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.20	11.57		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.17	16.78		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.83	14.22		
n=Max(gq-gf)/2,0)	5.09	8.39		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.59	2.01		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25	0.23		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.255	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.273 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.17			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.339			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	701			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.130
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	27.2	0.00	0.0	0.0	51.9
TR	0.0	0.00	30.0	27.1	0.00	0.0	0.0	34.3
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	8.5	0.0	129.7
TR	0.0	0.00	29.5	24.5	0.00	0.0	0.0	26.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.9	0.00	0.0	0.0	28.5
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.6
TR	0.0	0.00	35.0	29.3	0.00	0.0	0.0	31.5
	0.0						0.0	

Intersection Delay	44.1	sec/veh	Intersection LOS	D
--------------------	------	---------	------------------	---

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	123	463		274	368		224			292	119	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	464	1773		696	1741		1763			1728	1665	
LnCapacity	155	591		240	599		490			384	370	
Flow Ratio	0.3	0.3		0.4	0.2		0.1			0.2	0.1	
v/c Ratio	0.79	0.78		1.14	0.61		0.46			0.76	0.32	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.8	10.4		6.8	7.6		4.6			6.8	2.5	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.6	
Q2	0.7	1.8		6.4	1.2		0.6			1.6	0.3	
Q Average	3.5	12.2		13.2	8.8		5.2			8.4	2.8	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.3	
BOQ	4.4	14.8		16.0	10.7		6.4			10.3	3.5	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.5		1.5			1.5	1.6	
BOQ	5.4	17.5		18.8	12.8		7.8			12.2	4.3	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5		1.5	1.6		1.7			1.6	1.8	
BOQ	6.1	18.9		20.3	14.0		8.7			13.4	4.9	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7		1.7	1.8		2.0			1.8	2.2	
BOQ	7.3	20.7		22.1	15.6		10.2			15.0	6.0	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.8		1.8	2.0		2.2			2.0	2.6	
BOQ	8.5	22.4		23.9	17.2		11.6			16.6	7.1	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Condition
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								506	
Peak-Hour Factor, PHF								0.89	
Hourly Flow Rate, HFR								568	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		407							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		437							
Percent Heavy Vehicles		3							
Percent Grade (%)		0						0	
Flared Approach: Exists?/Storage								/	/
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			437						
C(m) (vph)			483						
v/c			0.90						
95% queue length			10.25						
Control Delay			50.1						
LOS			F						
Approach Delay				50.1					
Approach LOS				F					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: KWVP WB OR UT & No Bridge St
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Condition
Project ID: Charleston EIS
East/West Street: KWVP WB Off-Ramp U-Turn
North/South Street: North Bridge Street
Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					506	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					142	
Hourly Flow Rate, HFR					568	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	407					
Peak Hour Factor, PHF	0.93					
Peak-15 Minute Volume	109					
Hourly Flow Rate, HFR	437					
Percent Heavy Vehicles	3					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			568					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	568	
Potential Capacity	483	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	483	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 568
Potential Capacity 483
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 483

Results for Two-stage process:
a
y
C t 483

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	437					
Movement Capacity (vph)	483					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	483					
Volume	437					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			437					
C(m) (vph)			483					
v/c			0.90					
95% queue length			10.25					
Control Delay			50.1					
LOS			F					
Approach Delay				50.1				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	148	29	147	185	0	13	0	69	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.87	0.87	0.91	0.91	0.76	0.76		
Flow Rate	85	118	262	102	17	90		
% Heavy Veh	7	7	1	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	85	118	262	102	17	90		
Left-Turn	0	0	161	0	17	0		
Right-Turn	0	33	0	0	0	90		
Prop. Left-Turns	0.0	0.0	0.6	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.3	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	53	134	413	239	449	10	267	102	124	21	313	123
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	809	3166	0.84	0.26	41.0	D	41.0	D
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	889	3480	0.96	0.26	53.4	D	53.4	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	246	762	1.17	0.32	140.4	F		
TR	575	1784	0.42	0.32	26.2	C	88.1	F

Southbound

LTR	939	2913	0.52	0.32	26.8	C	26.8	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 52.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	53	134	413	239	449	10	267	102	124	21	313	123
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	15	38	117	73	137	3	72	27	33	6	83	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		681			851		287	243			486	
%InSharedLn												
Prop LTs		0.088			0.342		1.000	0.000			0.045	
Prop RTs		0.689			0.014			0.547			0.270	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	53	134	413	239	449	10	267	102	124	21	313	123
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	60	152	469	291	548	12	287	110	133	22	333	131
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	681			851			287 243			486		
Prop LTs	0.088			0.342			1.000 0.000			0.045		
Prop RTs	0.689			0.014			0.547			0.270		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.897			0.998			0.918			0.960		
fLT	0.996			0.983			0.392 1.000			0.934		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3166			3480			762 1784			2913		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	681	3166	# 0.22	0.26	809	0.84
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	851	3480	# 0.24	0.26	889	0.96
Right							
Northbound							
Prot							
Perm							
Left	DefL	287	762	# 0.38	0.32	246	1.17
Prot							
Perm							
Thru	TR	243	1784	0.14	0.32	575	0.42
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	486	2913	0.17	0.32	939	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.84
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.00

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.84	0.26	31.8	1.000	809	0.50	9.3	0.0	41.0	D	41.0	D
Westbound												
LTR	0.96	0.26	33.0	1.000	889	0.50	20.4	0.0	53.4	D	53.4	D
Northbound												
DefL	1.17	0.32	30.5	1.000	246	0.50	109.9	0.0	140.4	F		
TR	0.42	0.32	23.9	1.000	575	0.50	2.3	0.0	26.2	C	88.1	F
Southbound												
LTR	0.52	0.32	24.8	1.000	939	0.50	2.0	0.0	26.8	C	26.8	C

Intersection delay = 52.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			287	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			486	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.18	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.38	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			5.08	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			23.92	
n=Max(gq-gf)/2,0)			2.54	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.10	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.45	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			5.08	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.39	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.392	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	22
Proportion of LT in LT lane group, PLT	0.088 0.342 0.000 0.045
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	243
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.55
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.04
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	11.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.67
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.10
EL1 (refer to Exhibit C16-3)	1.78
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				243
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.045
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.689	0.014	0.547
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	31.8	0.00	0.0	0.0 0.0 0.0	41.0
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	33.0	0.00	0.0	0.0 0.0 0.0	53.4
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	10.2	0.0	140.4
TR	0.0 0.0	0.00	30.5	23.9	0.00	0.0	0.0 0.0	26.2
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	24.8	0.00	0.0	0.0 0.0 0.0	26.8
Intersection Delay			52.2	sec/veh	Intersection LOS			D

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	357		446		287	243	255	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	2 0	0 0	0 2 0	0 0	2 0	0 0
SL	1662		1827		762	1784	1529	
LnCapacity	424		466		246	575	493	
Flow Ratio	0.2		0.2		0.4	0.1	0.2	
v/c Ratio	0.84		0.96		1.17	0.42	0.52	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	8.5		11.0		7.2	4.8	5.2	
kB	0.6		0.6		0.4	0.8	0.7	
Q2	2.3		4.8		7.2	0.6	0.7	
Q Average	10.8		15.8		14.4	5.3	5.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	13.1		19.0		17.4	6.6	7.3	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.5	
BOQ	15.5		22.3		20.4	8.0	8.8	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.5		1.5	1.7	1.7	
BOQ	16.8		24.0		22.0	8.9	9.8	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.6		1.7	1.9	1.9	
BOQ	18.5		25.9		23.9	10.4	11.3	
QSRatio								
98th Percentile Output:								
fB%	1.9		1.8		1.8	2.2	2.2	
BOQ	20.2		27.8		25.7	11.8	12.8	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	747	361	4	3	372	590	2	3	2	123	0	285
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	800	1728	1.04	0.73	55.0+	E		
TR	1206	1644	0.34	0.73	4.8	A	38.6	D
Westbound								
LT	584	1876	0.68	0.31	31.1	C	106.2	F
R	497	1599	1.25	0.31	154.0	F		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.75	0.16	58.9	E		
LT	283	1818	0.00	0.16	32.1	C	26.2	C
R	862	1492	0.41	0.58	12.0	B		

Intersection Delay = 61.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	747	361	4	3	372	590	2	3	2	123	0	285
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
PK 15 Vol	208	100	1	1	98	155	1	2	1	38	0	89
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	830	405			395	621		17		154	0	356
%InSharedLn										0		
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.010			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.687			0.650			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X		X				Peds		
WB	Left			P			SB	Left	P	
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds							Peds		
NB	Right						EB	Right		
SB	Right	P					WB	Right		
Green		33.0	28.0					14.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	747	361	4	3	372	590	2	3	2	123	0	285
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
Adj flow	830	401	4	3	392	621	5	7	5	154	0	356
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	830	405			395	621		17		154	0	356
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.010			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.250											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1644		1876	1599		952			1310	1818	1492
Sec.	454											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	L	634	1728	# 0.37	0.367	634	1.00
Perm		196	454	# 0.43	0.367	166	1.18
Left		830			0.73	800	1.04
Prot	TR	405	1644	0.25	0.73	1206	0.34
Perm							
Thru							
Right	LT	395	1876	0.21	0.31	584	0.68
Prot							
Perm							
Left	R	621	1599	0.39	0.31	497	1.25
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Prot							
Perm							
Left	L	154	1310	# 0.12	0.16	204	0.75
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Prot							
Perm							
Left	R	356	1492	0.24	0.58	862	0.41
Prot							
Perm							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.92
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.03

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.04	0.73	18.5	1.000	800	0.50	36.6	0.0	55.0+	E			
TR	0.34	0.73	4.2	1.000	1206	0.50	0.5	0.0	4.8	A	38.6	D	
Westbound													
LT	0.68	0.31	27.0	1.000	584	0.50	4.1	0.0	31.1	C	106.2	F	
R	1.25	0.31	31.0	1.000	497	0.50	123.0	0.0	154.0	F			
Northbound													
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C	
Southbound													
L	0.75	0.16	36.4	1.000	204	0.50	22.6	0.0	58.9	E			
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	26.2	C	

R 0.41 0.58 10.5 1.000 862 0.50 1.5 0.0 12.0 B

Intersection delay = 61.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	830			154
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	395			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.75			3.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.88			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	17.43			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.57			14.00
n=Max(gq-gf)/2,0)	8.72			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.89			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	8.46			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	17.43			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.250			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.008	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	405	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.13	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.09	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		405		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.008		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	66.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	66.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.010
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	830			
v/c ratio from Capacity Worksheet, X	1.04			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	17.43			
Unopposed green interval, gu	15.57			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.27			
XPerm	1.76			
XProt	0.80			
Case	3			
Queue at beginning of green arrow, Qa	8.51			
Queue at beginning of unsaturated green, Qu	3.87			
Residual queue, Qr	3.17			
Uniform Delay, d1	18.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		18.5	0.00	7.5	0.0	55.0+
TR	0.0	0.00	12.0	4.2	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	27.0	0.00	0.0	0.0	31.1
R	0.0	0.00	31.0	31.0	0.00	31.0	0.0	154.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	36.4	0.00	0.0	0.0	58.9
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.5	0.00	0.0	0.0	12.0
Intersection Delay			61.0	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	830	405		395	621		17	154	0	356
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1091	1644		1876	1599		952	1310	1818	1492
LnCapacity	800	1206		584	497		148	204	283	862
Flow Ratio	0.8	0.2		0.2	0.4		0.0	0.1	0.0	0.2
v/c Ratio	1.04	0.34		0.68	1.25		0.11	0.75	0.00	0.41
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.7	3.6		8.6	15.5		0.4	3.7	0.0	4.9
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	10.4	0.5		1.0	17.5		0.0	1.0	0.0	0.7
Q Average	19.2	4.0		9.6	33.0		0.4	4.7	0.0	5.7
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.2	1.3	1.2
BOQ	23.0	5.0		11.7	39.7		0.5	5.8	0.0	7.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4		1.7	1.5	1.7	1.5
BOQ	27.0	6.2		13.9	46.3		0.7	7.1	0.0	8.5
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6	1.5		2.0	1.7	2.0	1.7
BOQ	29.0	6.9		15.2	49.6		0.8	7.9	0.0	9.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7	1.6		2.5	2.0	2.6	1.9
BOQ	31.1	8.3		16.8	52.9		1.0	9.3	0.0	10.9
QSRatio										
98th Percentile Output:										
fB%	1.7	2.4		1.9	1.7		3.1	2.3	3.2	2.2
BOQ	33.2	9.6		18.5	56.2		1.2	10.7	0.0	12.3
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2020 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	452	36	0	1	36	43	3	3	2	62	1	926
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	753	1506	0.67	0.50	21.3	C		
TR	1066	2132	0.04	0.50	11.5	B	20.6	C

LTR	1561	3122	0.05	0.50	11.6	B	11.6	B
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LTR	1220	3136	0.01	0.39	16.9	B	16.9	B
-----	------	------	------	------	------	---	------	---

LT	548	1410	0.12	0.39	18.1	B	83.4	F
R	616	1583	1.09	0.39	89.9	F		

Intersection Delay = 53.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	452	36	0	1	36	43	3	3	2	62	1	926
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	126	10	0	1	9	11	2	2	1	16	1	246
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	502	40			74			16			67	672
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	452	36	0	1	36	43	3	3	2	62	1	926
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	502	40	0	1	38	35	6	6	4	66	1	672
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	502	40			74			16			67	672
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.706	1.000			0.954			0.910		0.757	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1506	2132			3122			3136		1410	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	502	1506	# 0.33	0.50	753	0.67
Prot							
Perm							
Thru	TR	40	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	74	3122	0.02	0.50	1561	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3136	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	67	1410	0.05	0.39	548	0.12
Right	R	672	1583	# 0.42	0.39	616	1.09

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.76$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.85$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.67	0.50	16.9	1.000	753	0.50	4.4	0.0	21.3	C		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	20.6	C
Westbound												
LTR	0.05	0.50	11.5	1.000	1561	0.50	0.1	0.0	11.6	B	11.6	B
Northbound												
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.12	0.39	17.6	1.000	548	0.50	0.4	0.0	18.1	B	83.4	F

R 1.09 0.39 27.5 1.000 616 0.50 62.4 0.0 89.9 F

Intersection delay = 53.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	502			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	74			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	12.55			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.42			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.706			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	66	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.985
Proportion of LT in opposing flow, PLTo	0.00	0.99	0.38	
Adjusted opposing flow rate, Vo (veh/h)	40	67	16	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.65	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	1.67	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	4.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	30.10	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.01	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.99	
EL1 (refer to Exhibit C16-3)	1.44	1.48	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.757	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	74	40	67	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.473	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	16.9	0.00	0.0	0.0	21.3
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.1
R	0.0	0.00	27.5	27.5	0.00	14.0	0.0	89.9
Intersection Delay			53.9	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	502	40			38				8				67	672	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1506	2132			1639				1647				1410	1583	
LnCapacity	753	1066			819				640				548	616	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.4	
v/c Ratio	0.67	0.04			0.05				0.01				0.12	1.09	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	9.4	0.5			0.5				0.1				1.1	16.8	
kB	0.9	1.1			1.0				0.8				0.7	0.8	
Q2	1.7	0.0			0.0				0.0				0.1	12.2	
Q Average	11.1	0.6			0.5				0.1				1.2	29.0	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	13.4	0.7			0.7				0.2				1.5	34.8	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	15.9	0.9			0.9				0.2				1.9	40.7	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			1.9				2.0				1.9	1.5	
BOQ	17.3	1.1			1.0				0.3				2.2	43.6	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.4	1.6	
BOQ	19.0	1.4			1.3				0.3				2.8	46.5	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.0				3.2				2.9	1.7	
BOQ	20.7	1.7			1.6				0.4				3.4	49.5	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	193		24				2	276			673	364
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.41	0.32	18.2	B	17.9	B
R	473	1495	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1729 3346 0.18 0.52 8.0 A 8.0 A

Southbound

TR 1967 3808 0.58 0.52 11.0 B 11.0 B

Intersection Delay = 11.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	193		24				2	276		673	364	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	55		7				1	78		185	100	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	222		21					316			1140	
%InSharedLn												
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.351	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	193		24				2	276		673	364	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	222		21				2	314		740	400	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	222		21					316			1140	
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.351	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.926	0.926			0.990	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.947		
fLT	0.950				0.950	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1727	1495			3346	3808		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	222	1727	# 0.13	0.32	547	0.41
Prot							
Perm							
Thru							
Right	R	21	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	316	3346	0.09	0.52	1729	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1140	3808	# 0.30	0.52	1967	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.43
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.41	0.32	16.1	1.000	547	0.50	2.2	0.0	18.2	B	17.9	B
R	0.04	0.32	14.2	1.000	473	0.50	0.2	0.0	14.4	B		
Westbound												
Northbound												
LT	0.18	0.52	7.7	1.000	1729	0.50	0.2	0.0	8.0	A	8.0	A
Southbound												
TR	0.58	0.52	10.0	1.000	1967	0.50	1.0	0.0	11.0	B	11.0	B

Intersection delay = 11.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.006 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1140
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.98
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	9.45
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	4.50
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.950

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.45	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.305	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1140	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.006	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.351
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	16.1	0.00	0.0	0.0	18.2
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	8.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	10.0	0.00	0.0	0.0	11.0
	0.0						0.0	
Intersection Delay			11.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	222	21				165		598	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1727	1495				1757		1999	
LnCapacity	547	473				908		1033	
Flow Ratio	0.1	0.0				0.1		0.3	
v/c Ratio	0.41	0.04				0.18		0.58	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	2.9	0.2				1.5		6.9	
kB	0.5	0.5				0.8		0.7	
Q2	0.4	0.0				0.2		0.9	
Q Average	3.3	0.3				1.6		7.8	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	4.1	0.3				2.1		9.5	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.6		1.5	
BOQ	5.1	0.4				2.7		11.4	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	5.8	0.5				3.1		12.5	
QSRatio									
95th Percentile Output:									
fB%	2.1	2.5				2.3		1.8	
BOQ	6.9	0.7				3.8		14.1	
QSRatio									
98th Percentile Output:									
fB%	2.5	3.1				2.8		2.0	
BOQ	8.1	0.8				4.6		15.7	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		459	2		4			23	578	4
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
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Westbound

L	600	1439	0.43	0.42	14.6	B		
LT	576	1383	0.45	0.42	15.1	B	14.9	B

Northbound

L	248	595	0.02	0.42	10.4	B	10.4	B
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Southbound

LTR	2058	4940	0.32	0.42	12.2	B	12.2	B
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Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		459	2		4			23	578	4
% Heavy Veh	1	1		3	3		1			1	1	1
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol	1	0		129	1		1			6	159	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			258	260		5			664		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.992		1.000				0.038	
Prop RTs	0.000			0.000						0.006		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.988		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		459	2		4			23	578	4
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	4	0		516	2		5			25	635	4
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	4			258	260		5			664		
Prop LTs	0.000			1.000 0.992			1.000			0.038		
Prop RTs	0.000			0.000						0.006		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.999	
fLT	1.000		0.755 0.726		0.339		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1439 1383		595		4940	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	258	1439	0.18	0.42	600	0.43
Prot							
Perm							
Thru	LT	260	1383	# 0.19	0.42	576	0.45
Right							
Northbound							
Prot							
Perm							
Left	L	5	595	0.01	0.42	248	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	664	4940	# 0.13	0.42	2058	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.43	0.42	12.4	1.000	600	0.50	2.2	0.0	14.6	B		
LT	0.45	0.42	12.6	1.000	576	0.50	2.5	0.0	15.1	B	14.9	B
Northbound												
L	0.02	0.42	10.3	1.000	248	0.50	0.1	0.0	10.4	B	10.4	B
Southbound												
LTR	0.32	0.42	11.8	1.000	2058	0.50	0.4	0.0	12.2	B	12.2	B

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		258	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		4	664	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.30	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	4.06	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	3.12	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	21.88	
n=Max(gq-gf)/2,0)		0.00	1.56	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.58	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.54	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	3.12	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.34	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.339	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	258		
Proportion of LT in LT lane group, PLT	0.000	0.992	0.038
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		4	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		4.30	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.99	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.726	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	4		258	260	5			243	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	0	3
SL	1881		1439	1383	595			1813	
LnCapacity	784		600	576	248			755	
Flow Ratio	0.0		0.2	0.2	0.0			0.1	
v/c Ratio	0.01		0.43	0.45	0.02			0.32	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.988			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		3.1	3.1	0.0			2.7	
kB	0.7		0.6	0.6	0.3			0.7	
Q2	0.0		0.4	0.5	0.0			0.3	
Q Average	0.0		3.5	3.6	0.1			3.1	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.2	1.3			1.3	
BOQ	0.1		4.4	4.5	0.1			3.8	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.5	1.7			1.6	
BOQ	0.1		5.4	5.5	0.1			4.8	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.7	1.7	2.0			1.8	
BOQ	0.1		6.1	6.2	0.1			5.4	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.1	2.1	2.6			2.1	
BOQ	0.1		7.3	7.5	0.1			6.6	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.4	2.4	3.2			2.5	
BOQ	0.1		8.6	8.7	0.2			7.7	
QSRatio									

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	24
Peak-Hour Factor, PHF	0.71
Hourly Flow Rate, HFR	33
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	464
Peak Hour Factor, PHF	0.88
Hourly Flow Rate, HFR	527
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	527
C(m) (vph)	1043
v/c	0.51
95% queue length	2.93
Control Delay	11.9
LOS	B
Approach Delay	11.9
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		24				
Peak-Hour Factor, PHF		0.71				
Peak-15 Minute Volume		8				
Hourly Flow Rate, HFR		33				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			464			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			132			
Hourly Flow Rate, HFR			527			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					33			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	33	
Potential Capacity	1043	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1043	
Probability of Queue free St.	0.49	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.49
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.49
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			527			
Movement Capacity (vph)			1043			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1043			
Volume			527			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					527			
C(m) (vph)					1043			
v/c					0.51			
95% queue length					2.93			
Control Delay					11.9			
LOS					B			
Approach Delay				11.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	106	39	191	83	0	0	0	0	24	89	25
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	180		350				74 76	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	180		350				74	76
Left-Turn	0		244				26	0
Right-Turn	48		0				0	27
Prop. Left-Turns	0.0		0.7				0.4	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.4
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	39	91	0	0	209	19	65	100	141	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	161		291		115		192	
% Heavy Veh	2		5		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	161		291		115	192		
Left-Turn	48		0		65	0		
Right-Turn	0		24		0	142		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	192	182	115	8	47	9	414	105	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	544	1555	0.81	0.35	29.9	C	27.6	C
R	560	1599	0.13	0.35	13.8	B		

Westbound

LTR	525	1501	0.14	0.35	13.9	B	13.9	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2302	4762	0.25	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	192	182	115	8	47	9	414	105	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	56	54	34	2	14	3	116	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		440	73		73			585				
%InSharedLn												
Prop LTs		0.514			0.123			0.795				
Prop RTs		0.000	1.000		0.137			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3			17.5	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	192	182	115	8	47	9	414	105	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	226	214	73	9	54	10	465	118	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	440 73			73			585					
Prop LTs	0.514			0.123			0.795					
Prop RTs	0.000 1.000			0.137			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.990			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.982			0.999	
fLT	0.800			0.945			0.962	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1555	1599		1501			4762	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	440	1555	# 0.28	0.35	544	0.81
Right	R	73	1599	0.05	0.35	560	0.13
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	73	1501	0.05	0.35	525	0.14
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	585	4762	# 0.12	0.48	2302	0.25
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
LT	0.81	0.35	17.7	1.000	544	0.50	12.2	0.0	29.9	C	27.6	C
R	0.13	0.35	13.3	1.000	560	0.50	0.5	0.0	13.8	B		
Westbound												
LTR	0.14	0.35	13.3	1.000	525	0.50	0.6	0.0	13.9	B	13.9	B
Northbound												
LTR	0.25	0.48	9.1	1.000	2302	0.50	0.3	0.0	9.4	A	9.4	A
Southbound												

Intersection delay = 17.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo	1.000	1.000		0.908
----------------------------------	-------	-------	--	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gq > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	226	9	
Proportion of LT in LT lane group, PLT	0.514	0.123	0.795
Proportion of LT in opposing flow, PLTo	0.12	0.51	
Adjusted opposing flow rate, Vo (veh/h)	73	440	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.77	0.15	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.22	7.33	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	11.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	9.28	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	9.25	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.88	0.49	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.51	0.12	
EL1 (refer to Exhibit C16-3)	1.49	2.17	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.80	0.94	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.800	0.945	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	9.28		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.442		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	73	440	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.514	0.123	0.795	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.137	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	17.7	0.00	0.0	0.0	29.9
R	0.0	0.00	19.5	13.3	0.00	0.0	0.0	13.8
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.3	0.00	0.0	0.0	13.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.1	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			17.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	440	73	73		214			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1555	1599	1501		1748			
LnCapacity	544	560	525		845			
Flow Ratio	0.3	0.0	0.0		0.1			
v/c Ratio	0.81	0.13	0.14		0.25			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.999		0.996		0.980			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	6.6	0.8	0.8		2.1			
kB	0.6	0.6	0.5		0.7			
Q2	2.1	0.1	0.1		0.3			
Q Average	8.7	0.9	0.9		2.4			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.3			
BOQ	10.6	1.2	1.2		3.0			
QSRatio								
85th Percentile Output:								
fB%	1.5	1.6	1.6		1.6			
BOQ	12.6	1.5	1.5		3.7			
QSRatio								
90th Percentile Output:								
fB%	1.6	1.9	1.9		1.8			
BOQ	13.8	1.8	1.8		4.3			
QSRatio								
95th Percentile Output:								
fB%	1.8	2.4	2.4		2.2			
BOQ	15.4	2.2	2.2		5.2			
QSRatio								
98th Percentile Output:								
fB%	2.0	2.9	2.9		2.6			
BOQ	17.1	2.7	2.7		6.2			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	150		34				18	467		470	45	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	457	1714	0.42	0.27	20.9	C	20.9	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1099	1939	0.51	0.57	9.5	A	9.5	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1127	1989	0.50	0.57	9.2	A	9.2	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 11.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	150		34				18	467		470	45	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	39		9				5	136		128	12	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		191						564			560	
%InSharedLn												
Prop LTs		0.817						0.037			0.000	
Prop RTs		0.183						0.000			0.087	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	150		34				18	467		470	45	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	156		35				21	543		511	49	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		191						564			560	
Prop LTs		0.817						0.037			0.000	
Prop RTs		0.183						0.000			0.087	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.975						1.000			0.988		
fLT	0.961						0.974			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1714						1939			1989		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	191	1714	# 0.11	0.27	457	0.42
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	564	1939	# 0.29	0.57	1099	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	560	1989	0.28	0.57	1127	0.50
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.42	0.27	18.2	1.000	457	0.50	2.8	0.0	20.9	C	20.9	C
Westbound												
Northbound												
LT	0.51	0.57	7.9	1.000	1099	0.50	1.5	0.0	9.5	A	9.5	A
Southbound												
TR	0.50	0.57	7.8	1.000	1127	0.50	1.4	0.0	9.2	A	9.2	A

Intersection delay = 11.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		21	
Proportion of LT in LT lane group, PLT	0.817	0.037	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		560	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.35	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.33	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		16.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.16	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.44	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.974	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.16	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.181	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			560	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.037	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.087
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.2	0.00	0.0	0.0	20.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.9	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.8	0.00	0.0	0.0	9.2
	0.0						0.0	
Intersection Delay			11.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	191						564			560		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1714						1939			1989		
LnCapacity	457						1099			1127		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.42						0.51			0.50		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.6						5.7			5.6		
kB	0.5						0.8			0.8		
Q2	0.3						0.8			0.8		
Q Average	3.0						6.6			6.4		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	3.7						8.1			7.9		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	4.7						9.7			9.6		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	5.3						10.8			10.6		
QSRatio												
95th Percentile Output:												
fB%	2.2						1.9			1.9		
BOQ	6.4						12.3			12.1		
QSRatio												
98th Percentile Output:												
fB%	2.5						2.1			2.1		
BOQ	7.5						13.8			13.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	146		86				23	505		404	209	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								21	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	573	1718	0.50	0.33	18.9	B	18.9	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	890	1779	0.69	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	973	1945	0.66	0.50	14.3	B	14.3	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 15.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	146		86				23	505		404	209	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	46		27				7	147		110	57	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		289						614			643	
%InSharedLn												
Prop LTs		0.630						0.044			0.000	
Prop RTs		0.370						0.000			0.317	
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	146		86				23	505		404	209	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	182		107				27	587		439	204	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		289						614			643	
Prop LTs		0.630						0.044			0.000	
Prop RTs		0.370						0.000			0.317	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.950						1.000			0.957		
fLT	0.969						0.961			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1718						1779			1945		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	289	1718	# 0.17	0.33	573	0.50
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	614	1779	# 0.35	0.50	890	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	643	1945	0.33	0.50	973	0.66
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.50	0.33	16.0	1.000	573	0.50	2.9	0.0	18.9	B	18.9	B
Westbound												
Northbound												
LT	0.69	0.50	11.4	1.000	890	0.50	3.7	0.0	15.1	B	15.1	B
Southbound												
TR	0.66	0.50	11.2	1.000	973	0.50	3.1	0.0	14.3	B	14.3	B

Intersection delay = 15.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		27	
Proportion of LT in LT lane group, PLT	0.630	0.044	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		643	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.45	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.72	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		12.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		9.44	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.17	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.65	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.961	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			9.44	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.315	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		643	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.630		0.044	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.370	0.317
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.0	0.00	0.0	0.0	18.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.4	0.00	0.0	0.0	15.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	11.2	0.00	0.0	0.0	14.3
	0.0						0.0	
Intersection Delay			15.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	289						614			643		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1718						1779			1945		
LnCapacity	573						890			973		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.50						0.69			0.66		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.9						7.8			8.0		
kB	0.5						0.7			0.7		
Q2	0.5						1.4			1.4		
Q Average	4.4						9.2			9.4		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.5						11.2			11.4		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.7						13.3			13.6		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.5						14.6			14.8		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.8		
BOQ	8.9						16.2			16.5		
QSRatio												
98th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	10.2						17.9			18.1		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		118	282	463	274	53	206		499	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	32.6	C
R	220	1652	0.56	0.13	33.0	C		
Westbound								
LTR	1329	4689	0.87	0.28	24.7	C	24.7	C
Northbound								
L	124	373	0.47	0.33	27.1	C		
T	616	1848	0.36	0.33	16.7	B	18.9	B
Southbound								
TR	670	2010	0.87	0.33	31.2	C	31.2	C

Intersection Delay = 26.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		118	282	463	274	53	206		499	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		31	80	132	78	14	56		143	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		124		1157		58	224			580	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		118	282	463	274	53	206		499	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		124	320	526	311	58	224		574	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	4		124		1157		58	224			580	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.990	0.990	0.980	0.980	0.962	0.962
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.972	0.972
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.960	0.960		1.000	0.999	0.999
fLT	0.950		0.986	0.986	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4689	4689	373	1848	2010	2010
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	124	1652	# 0.08	0.13	220	0.56
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1157	4689	# 0.25	0.28	1329	0.87
Right							
Northbound							
Prot							
Perm							
Left	L	58	373	0.16	0.33	124	0.47
Prot							
Perm							
Thru	T	224	1848	0.12	0.33	616	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	580	2010	# 0.29	0.33	670	0.87
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	32.6	C	
R	0.56	0.13	24.4	1.000	220	0.50	8.6	0.0	33.0	C			
Westbound													
LTR	0.87	0.28	20.5	1.000	1329	0.50	4.2	0.0	24.7	C	24.7	C	
Northbound													
L	0.47	0.33	15.8	1.000	124	0.50	11.3	0.0	27.1	C	18.9	B	
T	0.36	0.33	15.2	1.000	616	0.50	1.5	0.0	16.7	B			
Southbound													
TR	0.87	0.33	18.7	1.000	670	0.50	12.4	0.0	31.2	C	31.2	C	

Intersection delay = 26.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			58	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			580	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			0.97	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.67	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			13.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			6.89	
n=Max(gq-gf)/2,0)			6.56	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.24	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			13.11	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.656	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			580	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		20.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	17.0		20.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.269	0.010
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	24.4	0.00	0.0	0.0	33.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.5	0.00	0.0	0.0	24.7
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.8	0.00	0.0	0.0	27.1
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.7	0.00	0.0	0.0	31.2
	0.0						0.0	
Intersection Delay			26.2	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	4	124	424	58	224	580
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	1 0
SL	1668	1652	1721	373	1848	2010
LnCapacity	222	220	487	124	616	670
Flow Ratio	0.0	0.1	0.2	0.2	0.1	0.3
v/c Ratio	0.02	0.56	0.87	0.47	0.36	0.87
Grn Ratio	0.13	0.13	0.28	0.33	0.33	0.33
I Factor		0.848	0.500		0.930	0.865
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	1.9	6.7	0.8	2.8	9.1
kB	0.3	0.3	0.3	0.2	0.6	0.6
Q2	0.0	0.3	1.5	0.2	0.3	2.9
Q Average	0.1	2.3	8.2	0.9	3.2	11.9
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.3	1.2	1.3	1.3	1.2
BOQ	0.1	2.8	10.0	1.2	4.0	14.4
QSRatio						
85th Percentile Output:						
fB%	1.7	1.6	1.5	1.6	1.6	1.4
BOQ	0.1	3.6	12.0	1.5	4.9	17.0
QSRatio						
90th Percentile Output:						
fB%	2.0	1.8	1.6	1.9	1.8	1.5
BOQ	0.1	4.1	13.1	1.8	5.6	18.5
QSRatio						
95th Percentile Output:						
fB%	2.6	2.2	1.8	2.4	2.1	1.7
BOQ	0.2	5.0	14.7	2.2	6.7	20.2
QSRatio						
98th Percentile Output:						
fB%	3.2	2.7	2.0	2.9	2.5	1.8
BOQ	0.2	6.0	16.3	2.7	7.9	21.9
QSRatio						

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	10	20	6				9	249	126	317	530	51
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 460 1623 0.13 0.28 16.5 B 16.5 B

Westbound

Northbound

LTR 950 1728 0.44 0.55 9.4 A 9.4 A

Southbound

L 524 953 0.65 0.55 13.0 B
 TR 986 1792 0.62 0.55 10.9 B 11.6 B

Intersection Delay = 11.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	20	6				9	249	126	317	530	51
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				3	68	34	85	142	14
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig			LTR						LTR	L		TR
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		58						418		341	612	
%InSharedLn												
Prop LTs			0.276						0.024	1.000	0.000	
Prop RTs		0.172						0.328			0.069	
Peds Bikes	0		0	0			0		0	0		0
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10	20	6				9	249	126	317	530	51
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
Adj flow	16	32	10				10	271	137	341	570	42
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L TR		
Adj flow	58						418			341 612		
Prop LTs	0.276						0.024			1.000 0.000		
Prop RTs	0.172						0.328			0.069		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L TR		
So	1900						1900			1900 1900		
Lanes 0	1	0	0	0	0	0	1	0		1	1	0
fW	1.033						1.133			1.000 1.000		
fHV	0.980						0.980			0.980 0.980		
fG	1.000						1.000			1.000 1.000		
fP	0.875						0.875			1.000 1.000		
fBB	1.000						0.992			1.000 0.972		
fA	1.000						1.000			1.000 1.000		
fLU	1.000						1.000			1.000 1.000		
fRT	0.977						0.956			0.990		
fLT	0.986						0.987			0.512 1.000		
Sec.												
fLpb	1.000						1.000			1.000 1.000		
fRpb	1.000						1.000			1.000		
S	1623						1728			953 1792		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	58	1623	# 0.04	0.28	460	0.13
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	418	1728	0.24	0.55	950	0.44
Right							
Southbound							
Prot							
Perm							
Left	L	341	953	# 0.36	0.55	524	0.65
Prot							
Perm							
Thru	TR	612	1792	0.34	0.55	986	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.13	0.28	16.0	1.000	460	0.50	0.6	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.44	0.55	8.0	1.000	950	0.50	1.4	0.0	9.4	A	9.4	A
Southbound												
L	0.65	0.55	9.5	1.000	524	0.50	3.5	0.0	13.0	B		
TR	0.62	0.55	9.2	1.000	986	0.50	1.7	0.0	10.9	B	11.6	B

Intersection delay = 11.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				341
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				418
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.68
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.97
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.30
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.70
n=Max(gq-gf)/2,0)				2.15
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.93
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.12
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				4.30
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.51
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.512

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		10	
Proportion of LT in LT lane group, PLT	0.276	0.024	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		612	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.17	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.20	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		20.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		7.43	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		12.15	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.57	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.987	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.43	4.30
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.225	0.130
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			612	418
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.024	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.172	0.328	0.069
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.0	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.0	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.5	0.00	0.0	0.0	13.0
TR	0.0	0.00	13.5	9.2	0.00	0.0	0.0	10.9
	0.0						0.0	

Intersection Delay	11.2	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		58						418			341	612
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1623						1728			953	1792
LnCapacity		460						950			524	986
Flow Ratio		0.0						0.2			0.4	0.3
v/c Ratio		0.13						0.44			0.65	0.62
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.922				0.564
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.7						4.1			4.0	7.0
kB		0.5						0.8			0.3	0.5
Q2		0.1						0.6			0.6	0.8
Q Average		0.8						4.7			4.5	7.7
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.0						5.9			5.6	9.5
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.5	1.5
BOQ		1.3						7.2			6.9	11.3
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.5						8.0			7.7	12.4
QSRatio												
95th Percentile Output:												
fB%		2.5						2.0			2.0	1.8
BOQ		1.9						9.4			9.1	14.0
QSRatio												
98th Percentile Output:												
fB%		3.0						2.3			2.3	2.0
BOQ		2.4						10.8			10.5	15.6
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	13	20	266	29	109	18	268	174	93	407	10
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 634 1427 0.09 0.44 14.7 B 14.7 B

Westbound

L 560 1259 0.55 0.44 21.8 C
 T 792 1783 0.04 0.44 14.2 B 19.7 B
 R 585 1316 0.21 0.44 16.1 B

Northbound

LTR 727 1636 0.69 0.44 23.5 C 23.5 C

Southbound

LTR 634 1426 0.92 0.44 30.2 C 30.2 C

Intersection Delay = 24.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	13	20	266	29	109	18	268	174	93	407	10
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	5	7	76	8	31	5	73	47	27	117	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		306	33	125		500			586	
%InSharedLn												
Prop LTs		0.158		1.000	0.000			0.040			0.183	
Prop RTs		0.509			0.000	1.000		0.378			0.019	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	13	20	266	29	109	18	268	174	93	407	10
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	19	29	306	33	125	20	291	189	107	468	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	57			306 33 125			500			586		
Prop LTs	0.158			1.000 0.000			0.040			0.183		
Prop RTs	0.509			0.000 1.000			0.378			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.949		0.997		
fLT	0.976		0.720	1.000		0.969		0.771		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.996		
fRpb	0.972		1.000 1.000			0.979		1.000		
S	1427		1259	1783	1316	1636		1426		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1427	0.04	0.44	634	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	306	1259	# 0.24	0.44	560	0.55
Prot							
Perm							
Thru	T	33	1783	0.02	0.44	792	0.04
Right	R	125	1316	0.09	0.44	585	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	500	1636	0.31	0.44	727	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	586	1426	# 0.41	0.44	634	0.92
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.65$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.74$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	634	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.55	0.44	18.3	1.000	560	0.50	3.4	0.0	21.8	C		
T	0.04	0.44	14.2	1.000	792	0.50	0.1	0.0	14.2	B	19.7	B
R	0.21	0.44	15.3	1.000	585	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.69	0.44	20.0	1.000	727	0.50	3.5	0.0	23.5	C	23.5	C
Southbound												
LTR	0.92	0.44	23.6	1.000	634	0.50	6.6	0.0	30.2	C	30.2	C

Intersection delay = 24.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	107
Proportion of LT in LT lane group, PLT	0.158	0.000	0.040
Proportion of LT in opposing flow, PLTo	0.00	0.18	0.04
Adjusted opposing flow rate, Vo (veh/h)	33	586	500
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.82	14.65	12.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	17.9	3.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.49	13.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	22.06	26.85
n=Max(gq-gf)/2,0)	0.00	0.00	5.03
PTHo=1-PLTo	1.00	0.82	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.18
EL1 (refer to Exhibit C16-3)	1.42	2.50	2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.64
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.05
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.976	0.969	0.771

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.49	13.15
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.387	0.329
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	33	57	586	500
OCCr	0.000	0.052	0.000	0.023
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.977
Proportion of left turns, PLT	0.158	1.000	0.040	0.183
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.509	1.000	0.378	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.972	1.000	0.979	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.3	0.00	0.0	0.0	21.8
T	0.0	0.00	25.0	14.2	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.0	0.00	0.0	0.0	23.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	23.6	0.00	0.0	0.0	30.2
	0.0						0.0	
Intersection Delay			24.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		57	306	33	125		500		586
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1427	1259	1783	1316		1636		1426
LnCapacity		634	560	792	585		727		634
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.09	0.55	0.04	0.21		0.69		0.92
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.905			0.663		0.229
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	5.6	0.5	1.9		10.0		13.8
kB		0.8	0.7	0.9	0.7		0.6		0.2
Q2		0.1	0.8	0.0	0.2		1.3		1.8
Q Average		0.9	6.4	0.5	2.1		11.3		15.6
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.2	7.9	0.7	2.7		13.7		18.8
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.5	9.5	0.8	3.4		16.1		22.0
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.6		1.5
BOQ		1.7	10.5	1.0	3.9		17.5		23.7
QSRatio									
95th Percentile Output:									
fB%		2.4	1.9	2.5	2.3		1.7		1.6
BOQ		2.2	12.1	1.3	4.8		19.2		25.7
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.9		1.8
BOQ		2.7	13.6	1.5	5.7		20.9		27.6
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	169		252	125	186		144		122			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left		P			SB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	933	1865	0.47	0.50	16.3	B	16.3	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	558	1115	0.67	0.50	23.2	C	23.2	C
----	-----	------	------	------	------	---	------	---

Northbound

LR	565	1453	0.70	0.39	29.7	C	29.7	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 22.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		169	252	125	186		144		122			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		52	77	38	56		54		46			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59						0			
Adj Flow		441			375			397				
%InSharedLn												
Prop LTs		0.000			0.403			0.542				
Prop RTs		0.533			0.000			0.458				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		169	252	125	186		144		122			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		206	235	151	224		215		182			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		441			375			397				
Prop LTs		0.000			0.403			0.542				
Prop RTs		0.533			0.000			0.458				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.928			1.000			0.938					
fLT	1.000			0.559			0.974					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1865			1115			1453					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	441	1865	0.24	0.50	933	0.47
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	375	1115	# 0.34	0.50	558	0.67
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	397	1453	# 0.27	0.39	565	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.47	0.50	14.7	1.000	933	0.50	1.6	0.0	16.3	B	16.3	B
Westbound												
LT	0.67	0.50	16.9	1.000	558	0.50	6.3	0.0	23.2	C	23.2	C
Northbound												
LR	0.70	0.39	23.1	1.000	565	0.50	6.6	0.0	29.7	C	29.7	C
Southbound												

Intersection delay = 22.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	151		
Proportion of LT in LT lane group, PLT	0.000	0.403	0.542
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	441		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.2		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	9.75		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.25		
n=Max(gq-gf)/2,0)	4.28		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.40		
EL1 (refer to Exhibit C16-3)	2.17		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.56		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.559		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.7	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	16.9	0.00	0.0	0.0	23.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	23.1	0.00	0.0	0.0	29.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			22.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		441			375			397				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1865			1115			1453				
LnCapacity		933			558			565				
Flow Ratio		0.2			0.3			0.3				
v/c Ratio		0.47			0.67			0.70				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.989			0.917				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		7.2			7.1			8.3				
kB		1.0			0.8			0.7				
Q2		0.9			1.4			1.5				
Q Average		8.1			8.5			9.9				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		9.9			10.4			12.0				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.4				
BOQ		11.8			12.4			14.3				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.6			1.6				
BOQ		13.0			13.5			15.5				
QSRatio												
95th Percentile Output:												
fB%		1.8			1.8			1.7				
BOQ		14.6			15.2			17.2				
QSRatio												
98th Percentile Output:												
fB%		2.0			2.0			1.9				
BOQ		16.2			16.8			18.9				
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Saturday 12:45-1:45 Peak Pd
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 No-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	27	33	24	62	17	41	12	238	50	29	269	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 238 2037 0.88 0.12 59.8 E 59.8 E

Westbound

LTR 501 2002 0.31 0.25 19.9 B 19.9 B

Northbound

LTR 762 1988 0.43 0.38 15.4 B 15.4 B

Southbound

LTR 732 1909 0.51 0.38 16.7 B 16.7 B

Intersection Delay = 25.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	27	33	24	62	17	41	12	238	50	29	269	28
% Heavy Veh	0	0	0	0	0	0	3	3	3	5	5	5
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
PK 15 Vol	17	21	15	20	5	13	3	65	14	8	76	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		209			154			326			371	
%InSharedLn												
Prop LTs		0.321			0.513			0.040			0.089	
Prop RTs		0.287			0.344			0.166			0.086	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	27	33	24	62	17	41	12	238	50	29	269	28
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
Adj flow	67	82	60	79	22	53	13	259	54	33	306	32
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	209			154			326			371		
Prop LTs	0.321			0.513			0.040			0.089		
Prop RTs	0.287			0.344			0.166			0.086		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	1.000			1.000			0.971			0.952		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.961			0.954			0.978			0.988		
fLT	0.984			0.975			0.981			0.949		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2037			2002			1988			1909		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	209	2037	# 0.10	0.12	238	0.88
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	154	2002	# 0.08	0.25	501	0.31
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	326	1988	0.16	0.38	762	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	371	1909	# 0.19	0.38	732	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.88	0.12	26.1	1.000	238	0.50	33.7	0.0	59.8	E	59.8	E	
Westbound													
LTR	0.31	0.25	18.3	1.000	501	0.50	1.6	0.0	19.9	B	19.9	B	
Northbound													
LTR	0.43	0.38	13.6	1.000	762	0.50	1.8	0.0	15.4	B	15.4	B	
Southbound													
LTR	0.51	0.38	14.2	1.000	732	0.50	2.5	0.0	16.7	B	16.7	B	

Intersection delay = 25.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			13	33
Proportion of LT in LT lane group, PLT	0.321	0.513	0.040	0.089
Proportion of LT in opposing flow, PLTo			0.09	0.04
Adjusted opposing flow rate, Vo (veh/h)			371	326
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.22	0.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.18	5.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			11.6	7.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			6.86	5.75
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.44	15.26
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.91	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.04	0.09
EL1 (refer to Exhibit C16-3)			2.02	1.93
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.09
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.981	0.949

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.75
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.250
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				326
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.089
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.287	0.166
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	26.1	0.00	0.0	0.0	59.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.3	0.00	0.0	0.0	19.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.6	0.00	0.0	0.0	15.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Intersection Delay			25.2	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	209		154		326		371	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	0 1 0	
SL	2037		2002		1988		1909	
LnCapacity	238		501		762		732	
Flow Ratio	0.1		0.1		0.2		0.2	
v/c Ratio	0.88		0.31		0.43		0.51	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	3.4		2.1		4.0		4.7	
kB	0.3		0.5		0.7		0.7	
Q2	1.6		0.2		0.5		0.7	
Q Average	5.0		2.3		4.5		5.4	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.2		1.2	
BOQ	6.2		2.9		5.6		6.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.5		1.5	
BOQ	7.6		3.7		6.9		8.2	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.7		1.7	
BOQ	8.4		4.2		7.7		9.1	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.2		2.0		1.9	
BOQ	9.9		5.2		9.1		10.5	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.6		2.3		2.2	
BOQ	11.3		6.1		10.5		12.0	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			280	13		16	338	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			304	14		18	384	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided				/		
RT Channelized?								
Lanes			1	0			0	1
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		10		19				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		13		25				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		18			38					
C(m) (vph)		1225			555					
v/c		0.01			0.07					
95% queue length		0.04			0.22					
Control Delay		8.0			12.0					
LOS		A			B					
Approach Delay					12.0					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		280	13	16	338	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		76	4	5	96	
Hourly Flow Rate, HFR		304	14	18	384	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0		0	1
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	10		19			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	13		25			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		384
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		318	731		311			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)	
s	1500
P(x)	
V(c,u,x)	

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	311	
Potential Capacity	727	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	727	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	318	
Potential Capacity	1225	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1225	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	731	
Potential Capacity	387	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.95
Movement Capacity	381	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity
Probability of Queue free St.

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 731
Potential Capacity 387
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.95
Movement Capacity 381

Results for Two-stage process:

a
y
C t 381

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	13		25			
Movement Capacity (vph)	381		727			
Shared Lane Capacity (vph)		555				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	381		727			
Volume	13		25			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		555				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		18		38				
C(m) (vph)		1225		555				
v/c		0.01		0.07				
95% queue length		0.04		0.22				
Control Delay		8.0		12.0				
LOS		A		B				
Approach Delay				12.0				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(il), Volume for stream 2 or 5		384
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	10	5	399	27	386	5	167	411	187	212	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1743	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	546	1311	0.85	0.42	28.9	C	26.7	C
R	539	1293	0.78	0.42	24.3	C		

Northbound

LTR	742	1781	0.86	0.42	27.2	C	27.2	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	381	914	1.15	0.42	111.0	F	111.0	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 45.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	399	27	386	5	167	411	187	212	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	108	7	105	2	46	113	51	58	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			463	420		641			438	
%InSharedLn												
Prop LTs		0.000			0.937			0.008			0.468	
Prop RTs		0.313			0.000	1.000		0.705			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	399	27	386	5	167	411	187	212	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	434	29	420	5	184	452	205	233	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			463 420			641			438		
Prop LTs	0.000			0.937			0.008			0.468		
Prop RTs	0.313			0.000 1.000			0.705			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.958			1.000 0.850			0.905			1.000		
fLT	1.000			0.728			0.997			0.441		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1311 1293			1781			914		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	463	1311	# 0.35	0.42	546	0.85
Right	R	420	1293	0.32	0.42	539	0.78
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	641	1781	0.36	0.42	742	0.86
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	438	914	# 0.48	0.42	381	1.15
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.83
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.00

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.85	0.42	15.8	1.000	546	0.50	13.1	0.0	28.9	C	26.7	C
R	0.78	0.42	15.1	1.000	539	0.50	9.2	0.0	24.3	C		
Northbound												
LTR	0.86	0.42	15.9	1.000	742	0.50	11.2	0.0	27.2	C	27.2	C
Southbound												
LTR	1.15	0.42	17.5	1.000	381	0.50	93.5	0.0	111.0	F	111.0	F

Intersection delay = 45.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	434	5	205
Proportion of LT in LT lane group, PLT	0.000	0.937	0.008	0.468
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.47	0.01
Adjusted opposing flow rate, Vo (veh/h)	463	16	438	641
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.23	0.08	3.42
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.72	0.27	7.30	10.68
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.24	0.00	7.69	11.96
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.76	25.00	9.12	13.04
n=Max(gq-gf)/2,0)	4.12	0.00	0.00	5.98
PTHo=1-PLTo	0.06	1.00	0.53	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.47
EL1 (refer to Exhibit C16-3)	2.22	1.40	2.16	2.64
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07		1.00	5.87
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	8.24	0.00	0.00	11.96
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67	0.73	1.00	0.44
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.728	0.997	0.441

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.24		7.69	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.330		0.308	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	463		438	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.8	0.00	0.0	0.0	28.9
R	0.0	0.00	17.5	15.1	0.00	0.0	0.0	24.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.9	0.00	0.0	0.0	27.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	14.3	0.0	111.0
	0.0						0.0	
Intersection Delay			45.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	16			463	420	641			438			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1743			1311	1293	1781			914			
LnCapacity	726			546	539	742			381			
Flow Ratio	0.0			0.4	0.3	0.4			0.5			
v/c Ratio	0.02			0.85	0.78	0.86			1.15			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.849		0.861			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.2			7.0	6.0	9.7			7.3			
kB	0.7			0.5	0.5	0.6			0.4			
Q2	0.0			2.2	1.5	3.1			9.6			
Q Average	0.2			9.2	7.6	12.8			16.9			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			11.1	9.2	15.5			20.4			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.4	1.5	1.4			1.4			
BOQ	0.3			13.3	11.1	18.2			23.9			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.6	1.5			1.5			
BOQ	0.3			14.5	12.2	19.7			25.7			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.8	1.8	1.7			1.6			
BOQ	0.4			16.1	13.8	21.5			27.6			
QSRatio												
98th Percentile Output:												
fB%	3.1			1.9	2.0	1.8			1.8			
BOQ	0.5			17.8	15.4	23.3			29.6			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				450		9		575			615	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2027 0.79 0.33 22.7 C 22.7 C

Northbound

T 1026 2051 0.62 0.50 13.2 B 13.2 B

Southbound

T 1027 2054 0.66 0.50 12.4 B 12.4 B

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				450		9	575			615		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				131		3	158			169		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					533		632			676		
%InSharedLn												
Prop LTs					0.981		0.000			0.000		
Prop RTs					0.019		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				450		9	575			615		
PHF				0.86		0.86	0.91			0.91		
Adj flow				523		10	632			676		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					533			632			676	
Prop LTs					0.981			0.000			0.000	
Prop RTs					0.019			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.997			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2027			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	533	2027	# 0.26	0.33	676	0.79
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	632	2051	0.31	0.50	1026	0.62
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	676	2054	# 0.33	0.50	1027	0.66
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.59

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.79	0.33	18.1	1.000	676	0.50	4.6	0.0	22.7	C	22.7	C
Northbound												
T	0.62	0.50	10.8	1.000	1026	0.50	2.4	0.0	13.2	B	13.2	B
Southbound												
T	0.66	0.50	11.2	1.000	1027	0.50	1.2	0.0	12.4	B	12.4	B

Intersection delay = 15.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.981 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.1	0.00	0.0	0.0	22.7
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.8	0.00	0.0	0.0	13.2
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.2	0.00	0.0	0.0	12.4
	0.0						0.0	
Intersection Delay			15.7	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		575	269			180	885	
Peak-Hour Factor, PHF		0.91	0.91			0.91	0.91	
Hourly Flow Rate, HFR		631	295			197	972	
Percent Heavy Vehicles		--	--			6	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		197						
C(m) (vph)		722						
v/c		0.27						
95% queue length		1.11						
Control Delay		11.8						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		575	269	180	885	
Peak-Hour Factor, PHF		0.91	0.91	0.91	0.91	
Peak-15 Minute Volume		158	74	49	243	
Hourly Flow Rate, HFR		631	295	197	972	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		972
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		926						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	926	
Potential Capacity	722	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	722	
Probability of Queue free St.	0.73	1.00
Maj L-Shared Prob Q free St.	0.36	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.36	0.36
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.73	0.73
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		197						
C(m) (vph)		722						
v/c		0.27						
95% queue length		1.11						
Control Delay		11.8						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.73
v(il), Volume for stream 2 or 5		972
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.36
d(M,LT), Delay for stream 1 or 4		11.8
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		7.5

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				107		228		598	93	163	698	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 392 1471 0.96 0.27 56.6 E 56.6 E

Northbound

TR 1131 1996 0.67 0.57 11.6 B 11.6 B

Southbound

LT 654 1155 1.45 0.57 216.3 F 216.3 F

Intersection Delay = 112.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				107		228	598	93		163	698	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				30		64	164	26		45	192	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					376			759			946	
%InSharedLn												
Prop LTs					0.319			0.000			0.189	
Prop RTs					0.681			0.134			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				107		228	598	93		163	698	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				120		256	657	102		179	767	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					376			759			946	
Prop LTs					0.319			0.000			0.189	
Prop RTs					0.681			0.134			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.908			0.982			1.000	
fLT					0.984			1.000			0.568	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1471			1996			1155	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	376	1471	# 0.26	0.27	392	0.96
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	759	1996	0.38	0.57	1131	0.67
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	946	1155	# 0.82	0.57	654	1.45
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.07
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.29

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.96	0.27	21.7	1.000	392	0.50	34.9	0.0	56.6	E	56.6	E
Northbound												
TR	0.67	0.57	9.1	1.000	1131	0.50	2.5	0.0	11.6	B	11.6	B
Southbound												
LT	1.45	0.57	13.0	1.000	654	0.50	203.3	0.0	216.3	F	216.3	F

Intersection delay = 112.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			179
Proportion of LT in LT lane group, PLT	0.319	0.000	0.189
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			759
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.98
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			9.08
gu=g-gq if gq>=gf, or = g-gf if gq<gf			24.92
n=Max(gq-gf)/2,0)			3.96
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.19
EL1 (refer to Exhibit C16-3)			2.96
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.57
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.568

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				9.08
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.267
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				759
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.189
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.681	0.134
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.7	0.00	0.0	0.0	56.6
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.1	0.00	0.0	0.0	11.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	73.0	0.0	216.3
	0.0						0.0	
Intersection Delay			112.8	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	103	49	122	31	92	88	172	728	144	69	576	99
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	476	1382	0.74	0.34	31.3	C	31.3	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	537	1559	0.54	0.34	27.6	C	27.6	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	289	531	0.65	0.54	20.6	C		
TR	1065	1957	0.89	0.54	24.9	C	24.2	C

Southbound

LTR	973	1788	0.81	0.54	23.6	C	23.6	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 25.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	103	49	122	31	92	88	172	728	144	69	576	99
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	33	16	39	11	32	30	47	198	39	19	157	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		351			289		187	948			787	
%InSharedLn												
Prop LTs		0.376			0.145		1.000	0.000			0.095	
Prop RTs		0.444			0.419			0.166			0.109	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	103	49	122	31	92	88	172	728	144	69	576	99
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	132	63	156	42	126	121	187	791	157	75	626	86
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	351			289			187 948			787		
Prop LTs	0.376			0.145			1.000 0.000			0.095		
Prop RTs	0.444			0.419			0.166			0.109		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.940			0.943			0.975			0.984		
fLT	0.683			0.912			0.302 1.000			0.570		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1382			1559			531 1957			1788		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	351	1382	# 0.25	0.34	476	0.74
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	289	1559	0.19	0.34	537	0.54
Right							
Northbound							
Prot							
Perm							
Left	L	187	531	0.35	0.54	289	0.65
Prot							
Perm							
Thru	TR	948	1957	# 0.48	0.54	1065	0.89
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	787	1788	0.44	0.54	973	0.81
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.74
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.74	0.34	25.9	1.000	476	0.50	5.4	0.0	31.3	C	31.3	C	
Westbound													
LTR	0.54	0.34	23.7	1.000	537	0.50	3.8	0.0	27.6	C	27.6	C	
Northbound													
L	0.65	0.54	14.4	1.000	289	0.50	6.2	0.0	20.6	C			
TR	0.89	0.54	18.1	1.000	1065	0.50	6.8	0.0	24.9	C	24.2	C	
Southbound													
LTR	0.81	0.54	16.7	1.000	973	0.50	6.9	0.0	23.6	C	23.6	C	

Intersection delay = 25.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			187	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.10	
Adjusted opposing flow rate, Vo (veh/h)			787	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			4.68	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.33	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			7.22	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			41.78	
n=Max(gq-gf)/2,0)			3.61	
PTHo=1-PLTo			0.90	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.82	
EL2=Max((1-Ptho**n)/Plto, 1.0)			3.18	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08	
gdifff=max(gq-gf,0)			7.22	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.30	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.302	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	132	42	75
Proportion of LT in LT lane group, PLT	0.376	0.145	0.000
Proportion of LT in opposing flow, PLTo	0.15	0.38	0.00
Adjusted opposing flow rate, Vo (veh/h)	289	351	948
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	3.30	1.05	1.88
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.22	8.77	23.70
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	7.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	9.25	11.53	40.62
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.75	19.47	8.38
n=Max(gq-gf)/2,0)	4.62	1.88	16.67
PTHo=1-PLTo	0.85	0.62	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.38	0.15	0.43
EL1 (refer to Exhibit C16-3)	1.86	1.98	3.55
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.55	1.56	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	9.24	3.75	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.68	0.91	0.23
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.683	0.912	0.570

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	9.25	11.53	7.22	40.62
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.298	0.372	0.147	0.829
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	289	351	787	948
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.376	0.145	1.000	0.095
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.444	0.419	0.166	0.109
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	25.9	0.00	0.0	0.0	31.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	23.7	0.00	0.0	0.0	27.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	14.4	0.00	0.0	0.0	20.6
TR	0.0	0.00	20.5	18.1	0.00	0.0	0.0	24.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	16.7	0.00	0.0	0.0	23.6
	0.0						0.0	
Intersection Delay			25.4	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	351		289		187	948	413	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1382		1559		531	1957	939	
LnCapacity	476		537		289	1065	511	
Flow Ratio	0.3		0.2		0.4	0.5	0.4	
v/c Ratio	0.74		0.54		0.65	0.89	0.81	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.7		5.8		3.3	20.9	8.4	
kB	0.4		0.7		0.3	0.7	0.7	
Q2	1.0		0.8		0.5	4.2	2.4	
Q Average	8.7		6.7		3.8	25.2	10.8	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	10.6		8.2		4.7	30.2	13.1	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.5	1.4	1.4	
BOQ	12.6		9.8		5.8	35.3	15.5	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.7	1.5	1.6	
BOQ	13.8		10.9		6.5	37.8	16.8	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.9		2.1	1.6	1.7	
BOQ	15.4		12.4		7.8	40.4	18.5	
QSRatio								
98th Percentile Output:								
fB%	2.0		2.1		2.4	1.7	1.9	
BOQ	17.0		13.9		9.1	43.0	20.2	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	392						918			687		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.68	0.33	31.4	C	31.4	C

Westbound

Northbound

T 2134 3842 0.45 0.56 12.2 B 12.2 B

Southbound

T 1951 3512 0.38 0.56 11.8 B 11.8 B

Intersection Delay = 16.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	392						918			687		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	114						239			187		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	456						956			747		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	392						918			687		
PHF	0.86						0.96			0.92		
Adj flow	456						956			747		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	456						956			747		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.980				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3842				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	456	2006	# 0.23	0.33	669	0.68
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	956	3842	# 0.25	0.56	2134	0.45
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	747	3512	0.21	0.56	1951	0.38
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.48
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.68	0.33	25.9	1.000	669	0.50	5.5	0.0	31.4	C	31.4	C	
Westbound													
Northbound													
T	0.45	0.56	11.8	1.000	2134	0.50	0.4	0.0	12.2	B	12.2	B	
Southbound													
T	0.38	0.56	11.3	1.000	1951	0.50	0.5	0.0	11.8	B	11.8	B	

Intersection delay = 16.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	456						502		392	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2017		1844	
LnCapacity	669						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.68						0.45		0.38	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.567		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	9.8						7.4		5.5	
kB	0.9						0.7		1.1	
Q2	1.7						0.6		0.7	
Q Average	11.6						8.0		6.2	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	14.0						9.8		7.6	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	16.5						11.7		9.2	
QSRatio										
90th Percentile Output:										
fB%	1.5						1.6		1.6	
BOQ	17.9						12.8		10.2	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	19.7						14.4		11.7	
QSRatio										
98th Percentile Output:										
fB%	1.8						2.0		2.1	
BOQ	21.4						16.0		13.3	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						687	
Peak-Hour Factor, PHF						0.92	
Hourly Flow Rate, HFR						746	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							57
Peak Hour Factor, PHF							0.88
Hourly Flow Rate, HFR							64
Percent Heavy Vehicles							5
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								64
C(m) (vph)								666
v/c								0.10
95% queue length								0.32
Control Delay								11.0
LOS								B
Approach Delay							11.0	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					687	
Peak-Hour Factor, PHF					0.92	
Peak-15 Minute Volume					187	
Hourly Flow Rate, HFR					746	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						57
Peak Hour Factor, PHF						0.88
Peak-15 Minute Volume						16
Hourly Flow Rate, HFR						64
Percent Heavy Vehicles						5
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								373
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St. 9 12

Conflicting Flows 373
Potential Capacity 666
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity 666
Probability of Queue free St. 1.00 0.90

Step 2: LT from Major St. 4 1

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00
Maj L-Shared Prob Q free St.

Step 3: TH from Minor St. 8 11

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 0.90 1.00
Movement Capacity

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 8 11

Part 1 - First Stage

Conflicting Flows
Potential Capacity 900 424
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 900 424
Probability of Queue free St. 1.00 1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	424	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	424	900

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	472
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	472

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.90	1.00
Movement Capacity		

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						666
Volume						64
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								64
C(m) (vph)								666
v/c								0.10
95% queue length								0.32
Control Delay								11.0
LOS								B
Approach Delay							11.0	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	99	301	215	272	623	100	153	304	221	241	115	92
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	86	258	1.23	0.33	186.6	F		
TR	593	1780	0.85	0.33	38.3	D	64.1	E
Westbound								
L	115	334	2.46	0.34	709.9	F		
TR	1187	3446	0.77	0.34	30.7	C	191.4	F
Northbound								
LTR	951	3425	0.79	0.28	36.9	D	36.9	D
Southbound								
L	384	1728	0.75	0.22	43.5	D		
TR	364	1638	0.68	0.22	40.5	D	42.1	D

Intersection Delay = 102.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
Intersection: Veterans Rd W & Bricktown/KWVP
Area Type: All other areas
Jurisdiction: Staten Island
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
E/W St: Veterans Road West

N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	99	301	215	272	623	100	153	304	221	241	115	92
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	27	81	58	71	200	32	43	84	61	72	34	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	106	504		283	913			754		287	247	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.225			0.000	
Prop RTs		0.357			0.125			0.326			0.445	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	99	301	215	272	623	100	153	304	221	241	115	92
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	106	324	180	283	799	114	170	338	246	287	137	110
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	106	504		283	913			754		287	247	
Prop LTs	1.000	0.000		1.000	0.000			0.225			0.000	
Prop RTs		0.357			0.125			0.326			0.445	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.946			0.981		0.951				0.933	
fLT	0.142	1.000		0.180	1.000		0.989			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	258	1780		334	3446		3425			1728	1638	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	106	258	0.41	0.33	86	1.23
Prot							
Perm							
Thru	TR	504	1780	0.28	0.33	593	0.85
Right							
Westbound							
Prot							
Perm							
Left	L	283	334	# 0.85	0.34	115	2.46
Prot							
Perm							
Thru	TR	913	3446	0.26	0.34	1187	0.77
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	754	3425	# 0.22	0.28	951	0.79
Right							
Southbound							
Prot							
Perm							
Left	L	287	1728	# 0.17	0.22	384	0.75
Prot							
Perm							
Thru	TR	247	1638	0.15	0.22	364	0.68
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.23
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.46

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.23	0.33	30.0	1.000	86	0.50	156.6	0.0	186.6	F			
TR	0.85	0.33	27.9	1.000	593	0.50	10.4	0.0	38.3	D	64.1	E	
Westbound													
L	2.46	0.34	29.5	1.000	115	0.50	680.4	0.0	709.9	F			
TR	0.77	0.34	26.3	1.000	1187	0.50	4.4	0.0	30.7	C	191.4	F	
Northbound													
LTR	0.79	0.28	30.1	1.000	951	0.50	6.8	0.0	36.9	D	36.9	D	
Southbound													
L	0.75	0.22	32.6	1.000	384	0.50	10.8	0.0	43.5	D			
TR	0.68	0.22	32.1	1.000	364	0.50	8.4	0.0	40.5	D	42.1	D	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.225 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	16.43			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.548			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	913			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	5.0	0.0	186.6
TR	0.0	0.00	30.0	27.9	0.00	0.0	0.0	38.3
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	42.0	0.0	709.9
TR	0.0	0.00	29.5	26.3	0.00	0.0	0.0	30.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	30.1	0.00	0.0	0.0	36.9
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.6	0.00	0.0	0.0	43.5
TR	0.0	0.00	35.0	32.1	0.00	0.0	0.0	40.5
	0.0						0.0	

Intersection Delay	102.9	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	106	504		283	479		396			287	247	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	258	1780		334	1809		1798			1728	1638	
LnCapacity	86	593		115	623		499			384	364	
Flow Ratio	0.4	0.3		0.8	0.3		0.2			0.2	0.2	
v/c Ratio	1.23	0.85		2.46	0.77		0.79			0.75	0.68	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.7	11.7		7.1	10.7		9.2			6.7	5.7	
kB	0.1	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	3.1	2.6		21.4	2.2		2.3			1.3	1.0	
Q Average	5.8	14.3		28.5	12.9		11.5			8.0	6.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	7.1	17.2		34.2	15.5		13.9			9.8	8.1	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.4		1.4			1.5	1.5	
BOQ	8.6	20.2		39.9	18.3		16.4			11.7	9.8	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5		1.5	1.5		1.6			1.6	1.6	
BOQ	9.6	21.8		42.7	19.8		17.8			12.8	10.8	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.7		1.6	1.7		1.7			1.8	1.9	
BOQ	11.0	23.7		45.6	21.6		19.5			14.5	12.3	
QSRatio												
98th Percentile Output:												
fB%	2.2	1.8		1.7	1.8		1.9			2.0	2.1	
BOQ	12.5	25.5		48.5	23.4		21.2			16.1	13.9	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								601	
Peak-Hour Factor, PHF								0.93	
Hourly Flow Rate, HFR								646	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		178							
Peak Hour Factor, PHF		0.90							
Hourly Flow Rate, HFR		197							
Percent Heavy Vehicles		1							
Percent Grade (%)		0						0	
Flared Approach: Exists?/Storage								/	/
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			197							
C(m) (vph)			438							
v/c			0.45							
95% queue length			2.28							
Control Delay			19.8							
LOS			C							
Approach Delay				19.8						
Approach LOS				C						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 601
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 162
 Hourly Flow Rate, HFR 646
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 49
 Hourly Flow Rate, HFR 197
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			646					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	646	
Potential Capacity	438	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	438	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 646
Potential Capacity 438
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 438

Results for Two-stage process:
a
y
C t 438

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	197					
Movement Capacity (vph)	438					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	438					
Volume	197					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			197					
C(m) (vph)			438					
v/c			0.45					
95% queue length			2.28					
Control Delay			19.8					
LOS			C					
Approach Delay				19.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	251	33	110	243	0	57	0	94	0	0	0
% Thrus Left Lane			50			50						

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	T	TR	LT	T	L	R		
PHF	0.85	0.85	0.91	0.91	0.89	0.89		
Flow Rate	147	186	252	134	64	105		
% Heavy Veh	0	0	0	1	1	1		
No. Lanes		2		2		2		
Opposing-Lanes		2		2		0		
Conflicting-lanes		2		2		2		
Geometry group		5		5		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	147	186	252	134	64	105		
Left-Turn	0	0	120	0	64	0		
Right-Turn	0	38	0	0	0	105		
Prop. Left-Turns	0.0	0.0	0.5	0.0	1.0	0.0		
Prop. Right-Turns	0.0	0.2	0.0	0.0	0.0	1.0		
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0		
Geometry Group		5		5		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.2		

hRT-adj	-0.7	-0.7	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.0	-0.1	0.2
	0.0	0.0	0.2
	-0.6		

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	147	186	252	134	64	105		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.13	0.17	0.22	0.12	0.06	0.09		
hd, final value	5.37	5.23	5.54	5.32	5.71	4.91		
x, final value	0.22	0.27	0.39	0.20	0.10	0.14		
Move-up time, m		2.3		2.3		2.0		
Service Time	3.1	2.9	3.2	3.0	3.7	2.9		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	147	186	252	134	64	105		
Service Time	3.1	2.9	3.2	3.0	3.7	2.9		
Utilization, x	0.22	0.27	0.39	0.20	0.10	0.14		
Dep. headway, hd	5.37	5.23	5.54	5.32	5.71	4.91		
Capacity	397	436	502	384	314	355		
Delay	9.57	9.85	11.71	9.33	9.35	8.73		
LOS	A	A	B	A	A	A		
Approach:								
Delay		9.73		10.88		8.96		
LOS		A		B		A		
Intersection Delay	10.08							

Intersection LOS B

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL TR			LTR		
Volume	81	150	492	235	524	25	314	206	115	26	537	167
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 809 3167 0.97 0.26 55.9 E 55.9 E

Westbound

LTR 898 3512 1.12 0.26 100.2 F 100.2 F

Northbound

DefL 131 408 2.55 0.32 749.7 F
 TR 593 1840 0.59 0.32 29.9 C 380.4 F

Southbound

LTR 961 2981 0.82 0.32 35.7 D 35.7 D

Intersection Delay = 132.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81	150	492	235	524	25	314	206	115	26	537	167
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	22	41	134	75	168	8	84	57	32	7	144	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		786			1005		334	352			785	
%InSharedLn												
Prop LTs		0.112			0.300		1.000	0.000			0.036	
Prop RTs		0.681			0.032			0.358			0.229	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81	150	492	235	524	25	314	206	115	26	537	167
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	88	163	535	301	672	32	334	226	126	28	577	180
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	786			1005			334 352			785		
Prop LTs	0.112			0.300			1.000 0.000			0.036		
Prop RTs	0.681			0.032			0.358			0.229		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.898			0.995			0.946			0.966		
fLT	0.994			0.985			0.194 1.000			0.931		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3167			3512			408 1840			2981		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	786	3167	# 0.25	0.26	809	0.97
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1005	3512	# 0.29	0.26	898	1.12
Right							
Northbound							
Prot							
Perm							
Left	DefL	334	408	# 0.82	0.32	131	2.55
Prot							
Perm							
Thru	TR	352	1840	0.19	0.32	593	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	785	2981	0.26	0.32	961	0.82
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.35
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.62

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.97	0.26	33.2	1.000	809	0.50	22.7	0.0	55.9	E	55.9	E
Westbound												
LTR	1.12	0.26	33.5	1.000	898	0.50	66.7	0.0	100.2	F	100.2	F
Northbound												
DefL	2.55	0.32	30.5	1.000	131	0.50	719.2	0.0	749.7	F		
TR	0.59	0.32	25.6	1.000	593	0.50	4.3	0.0	29.9	C	380.4	F
Southbound												
LTR	0.82	0.32	28.1	1.000	961	0.50	7.6	0.0	35.7	D	35.7	D

Intersection delay = 132.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			334	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			785	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			8.35	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.31	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			13.12	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.88	
n=Max(gq-gf)/2,0)			6.56	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.82	
EL2=Max((1-Ptho*n)/Plto, 1.0)			5.94	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			13.12	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.19	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.194	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	28
Proportion of LT in LT lane group, PLT	0.112 0.300 0.000 0.036
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	352
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.70
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.40
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	1.61
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.35
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	1.98
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.931

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				1.61
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.056
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				352
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.036
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.681	0.032	0.358
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.2	0.00	0.0	0.0	55.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	26.7	0.0	100.2
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	50.7	0.0	749.7
TR	0.0	0.00	30.5	25.6	0.00	0.0	0.0	29.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	28.1	0.00	0.0	0.0	35.7
	0.0						0.0	
Intersection Delay			132.9	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	412		527		334	352	412	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1663		1844		408	1840	1565	
LnCapacity	424		471		131	593	504	
Flow Ratio	0.2		0.3		0.8	0.2	0.3	
v/c Ratio	0.97		1.12		2.55	0.59	0.82	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	10.2		13.2		8.4	7.4	9.5	
kB	0.5		0.6		0.3	0.8	0.7	
Q2	4.5		10.6		25.8	1.1	2.6	
Q Average	14.7		23.8		34.2	8.5	12.1	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	17.7		28.6		41.0	10.3	14.6	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.4	
BOQ	20.8		33.4		47.9	12.4	17.2	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.5	
BOQ	22.4		35.8		51.3	13.5	18.6	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.6		1.6	1.8	1.7	
BOQ	24.3		38.3		54.7	15.1	20.4	
QSRatio								
98th Percentile Output:								
fB%	1.8		1.7		1.7	2.0	1.8	
BOQ	26.1		40.8		58.1	16.8	22.1	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 6/19/2013	Jurisd: Sat Flw Rate EB-L = 2100
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	877	433			474	782				200		213
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left	P	
	Thru		P				Thru		
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	895	1909	1.01	0.72	33.8	C		
T	1170	1646	0.39	0.71	5.7	A	24.4	C

T	460	1881	1.10	0.24	83.9	F	348.0	F
R	391	1599	2.06	0.24	513.2	F		

Southbound						
L	576	3239	0.38	0.18	34.5	C

R 962 1492 0.24 0.64 7.3 A
Intersection Delay = 160.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	877	433		474	782					200		213
% Heavy Veh	1	1		1	1					1		1
PHF	0.97	0.96		0.94	0.97					0.92		0.92
PK 15 Vol	226	113		126	202					54		58
Hi Ln Vol												
% Grade		0		0						0		
Ideal Sat	2100	1900		1900	1900					1900		1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0		12.0	12.0					10.0		10.0
RTOR Vol					0							0
Adj Flow	904	451		504	806					217		232
%InSharedLn												
Prop LTs	1.000	0.000		0.000								
Prop RTs		0.000		0.000	1.000							1.000
Peds Bikes				0			0			0		
Buses	0	0		0	0					0		0
%InProtPhase	50.0											
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0					0.0		0.0
Arriv. Type	3	3		3	3					3		3
Unit Ext.	3.0	3.0		3.0	3.0					3.0		3.0
I Factor		0.508		0.176						1.000		
Lost Time	2.0	2.0		2.0	2.0					2.0		2.0
Ext of g	3.0	2.0		2.0	2.0					2.0		2.0
Ped Min g				24.6			3.2			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	877	433			474	782							200		213
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	904	451			504	806							217		232
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T	R		L	T	R
Adj flow	904	451			504	806			217				217		232
Prop LTs	1.000	0.000			0.000										
Prop RTs		0.000			0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T	R		L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0				2	0	1
fW	0.967	1.000			1.000	1.000							0.933		0.933
fHV	0.990	0.990			0.990	0.990							0.990		0.990
fG	1.000	1.000			1.000*1.000*								1.000		1.000
fP	1.000	0.875			1.000	1.000							1.000		1.000
fBB	1.000	1.000			1.000	1.000							1.000		1.000
fA	1.000	1.000			1.000	1.000							1.000		1.000
fLU	1.000	1.000			1.000	1.000							0.971		1.000
fRT		1.000			1.000	0.850									0.850
fLT	0.950	1.000			1.000								0.950		
Sec.	0.148														
fLpb	1.000	1.000			1.000								1.000		
fRpb		1.000			1.000	1.000									1.000
S	1909	1646			1881	1599							3239		1492
Sec.	298														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

R 0.24 0.64 6.7 1.000 962 0.50 0.6 0.0 7.3 A

Intersection delay = 160.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			
Effective permitted green time for LT lane group, g(s)	27.0			
Opposing effective green time, go (s)	22.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	904			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	504			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	22.60			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.60			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			
gq, (see Exhibit C16-4,5,6,7,8)	26.44			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.56			
n=Max(gq-gf)/2,0)	13.22			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.09			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	904			
v/c ratio from Capacity Worksheet, X	1.01			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	22.44			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	25.6			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.25			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	3.43			
XPerm	0.48			
XProt	0.78			
Case	1			
Queue at beginning of green arrow, Qa	6.35			
Queue at beginning of unsaturated green, Qu	5.58			
Residual queue, Qr	0.00			
Uniform Delay, d1	9.8			

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		9.8	0.00	2.3	0.0	33.8
T	0.0	0.00	13.0	5.2	0.00	0.0	0.0	5.7
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	34.0	34.0	0.00	11.0	0.0	83.9
R	0.0	0.00	34.0	34.0	0.00	103.8	0.0	513.2
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.6	0.00	0.0	0.0	34.5
	0.0						0.0	
R	0.0	0.00	16.0	6.7	0.00	0.0	0.0	7.3
Intersection Delay			160.0	sec/veh	Intersection LOS F			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	904	451		504	806				111	232
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1240	1646		1881	1599				1668	1492
LnCapacity	895	1170		460	391				296	962
Flow Ratio	0.7	0.3		0.3	0.5				0.1	0.2
v/c Ratio	1.01	0.39		1.10	2.06				0.38	0.24
Grn Ratio	0.72	0.71		0.24	0.24				0.18	0.64
I Factor		0.508		0.176						1.000
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00	1.00				1.00	1.00
Q1	10.9	4.5		12.6	20.1				2.4	2.4
kB	0.5	0.6		0.1	0.1				0.5	1.1
Q2	8.4	0.4		6.6	52.1				0.3	0.4
Q Average	19.2	4.9		19.2	72.2				2.7	2.8
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2				1.3	1.3
BOQ	23.1	6.1		23.1	86.7				3.4	3.5
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4				1.6	1.6
BOQ	27.1	7.4		27.0	101				4.3	4.4
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5				1.8	1.8
BOQ	29.1	8.3		29.0	108				4.9	5.0
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.6	1.6				2.2	2.2
BOQ	31.2	9.7		31.2	116				6.0	6.1
QSRatio										
98th Percentile Output:										
fB%	1.7	2.3		1.7	1.7				2.6	2.6
BOQ	33.3	11.1		33.3	123				7.0	7.1
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/2013	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 No-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	589	46	0	0	46	58	0	0	1	84	0	1211
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	736	1471	0.83	0.50	29.7	C		
TR	1066	2132	0.05	0.50	11.6	B	28.4	C

LTR	1633	3266	0.06	0.50	11.7	B	11.7	B
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	544	1399	0.17	0.39	18.5	B	199.4	F
R	622	1599	1.41	0.39	218.0	F		

```
Intersection Delay = 123.0 (sec/veh)    Intersection LOS = F
```

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	589	46	0	0	46	58	0	0	1	84	0	1211
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	153	12	0	0	13	16	0	0	1	23	0	326
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	614	48			99			1			90	874
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0		0	0	
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.967		1.000			1.000			0.855		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3		17.5			20.3			20.3		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	589	46	0	0	46	58	0	0	1	84	0	1211
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	614	48	0	0	51	48	0	0	1	90	0	874
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	614	48			99			1			90	874
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.690	1.000		1.000			1.000			0.744	
Sec.											
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	1471	2132		3266			3045			1399	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	614	1471	# 0.42	0.50	736	0.83
Prot							
Perm							
Thru	TR	48	2132	0.02	0.50	1066	0.05
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	99	3266	0.03	0.50	1633	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	90	1399	0.06	0.39	544	0.17
Right	R	874	1599	# 0.55	0.39	622	1.41

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.96
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.08

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.83	0.50	19.3	1.000	736	0.50	10.4	0.0	29.7	C			
TR	0.05	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	28.4	C	
Westbound													
LTR	0.06	0.50	11.6	1.000	1633	0.50	0.1	0.0	11.7	B	11.7	B	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.17	0.39	18.0	1.000	544	0.50	0.6	0.0	18.5	B	199.4	F	

R 1.41 0.39 27.5 1.000 622 0.50 190.5 0.0 218.0 F

Intersection delay = 123.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	614			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	99			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	15.35			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.30			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.45			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.690			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	90
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	48	90	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.25
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.60	2.25	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.77
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.744

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	99	48	90	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.485	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	19.3	0.00	0.0	0.0	29.7
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	18.0	0.00	0.0	0.0	18.5
R	0.0	0.00	27.5	27.5	0.00	63.0	0.0	218.0
Intersection Delay			123.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	614	48			51				0				90	874	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1471	2132			1715				1599				1399	1599	
LnCapacity	736	1066			857				621				544	622	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.5	
v/c Ratio	0.83	0.05			0.06				0.00				0.17	1.41	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	13.2	0.6			0.7				0.0				1.5	21.9	
kB	0.9	1.2			1.0				0.8				0.6	0.7	
Q2	3.6	0.1			0.1				0.0				0.1	33.8	
Q Average	16.8	0.7			0.7				0.0				1.6	55.6	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	20.2	0.9			0.9				0.0				2.0	66.7	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	23.7	1.1			1.2				0.0				2.6	77.9	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	25.5	1.3			1.4				0.0				3.0	83.4	
QSRatio															
95th Percentile Output:															
fB%	1.6	2.5			2.5				2.6				2.3	1.6	
BOQ	27.4	1.7			1.8				0.0				3.7	89.0	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			3.0				3.2				2.8	1.7	
BOQ	29.4	2.0			2.2				0.0				4.5	94.5	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	310		35				5	285			749	637
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.64	0.32	22.3	C	21.7	C
R	497	1568	0.06	0.32	14.5	B		
Westbound								

Northbound

LT 1684 3260 0.20 0.52 8.1 A 8.1 A

Southbound

TR 1953 3780 0.80 0.52 13.7 B 13.7 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	310		35				5	285		749	637	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	91		10				2	81		210	179	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	365		31					330			1558	
%InSharedLn												
Prop LTs								0.018			0.000	
Prop RTs			1.000					0.000			0.460	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	310		35				5	285		749	637	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	365		31				6	324		842	716	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	365		31					330			1558	
Prop LTs								0.018			0.000	
Prop RTs			1.000					0.000			0.460	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.971	0.971			0.990		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.931	
fLT	0.950				0.926		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1811	1568			3260		3780	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	365	1811	# 0.20	0.32	573	0.64
Prot							
Perm							
Thru							
Right	R	31	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	330	3260	0.10	0.52	1684	0.20
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1558	3780	# 0.41	0.52	1953	0.80
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.64	0.32	17.5	1.000	573	0.50	4.8	0.0	22.3	C	21.7	C
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B		
Westbound												
Northbound												
LT	0.20	0.52	7.8	1.000	1684	0.50	0.3	0.0	8.1	A	8.1	A
Southbound												
TR	0.80	0.52	11.9	1.000	1953	0.50	1.7	0.0	13.7	B	13.7	B

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.018 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1558
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.64
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	19.17
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.83
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	6.82
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.926

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			19.17	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.618	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1558	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.018	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.460
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	17.5	0.00	0.0	0.0	22.3
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.8	0.00	0.0	0.0	8.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.9	0.00	0.0	0.0	13.7
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	365	31				173		818	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1712		1985	
LnCapacity	573	497				884		1025	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.64	0.06				0.20		0.80	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	5.2	0.4				1.6		11.2	
kB	0.5	0.5				0.8		0.4	
Q2	0.9	0.0				0.2		1.6	
Q Average	6.1	0.4				1.7		12.8	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	7.5	0.5				2.2		15.5	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	9.1	0.7				2.8		18.2	
QSRatio									
90th Percentile Output:									
fB%	1.6	2.0				1.9		1.5	
BOQ	10.0	0.8				3.2		19.7	
QSRatio									
95th Percentile Output:									
fB%	1.9	2.5				2.3		1.7	
BOQ	11.5	1.0				4.0		21.5	
QSRatio									
98th Percentile Output:									
fB%	2.1	3.1				2.8		1.8	
BOQ	13.1	1.2				4.8		23.2	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Volume	1	0		706	2		5			28	680	1
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	606	1454	0.96	0.42	44.5	D		
LT	582	1398	0.34	0.42	13.4	B	36.7	D

Northbound

L	207	496	0.03	0.42	10.6	B	10.6	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2040	4895	0.39	0.42	12.8	B	12.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 24.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		706	2		5			28	680	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		194	1		2			8	191	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			582	196		6			796		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.990		1.000				0.039	
Prop RTs	0.000			0.000						0.001		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		706	2		5			28	680	1
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	4	0		776	2		6			31	764	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			582	196		6			796		
Prop LTs	0.000			1.000 0.990			1.000			0.039		
Prop RTs	0.000			0.000						0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.726		0.280		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1454 1398		496		4895	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	582	1454	# 0.40	0.42	606	0.96
Prot							
Perm							
Thru	LT	196	1398	0.14	0.42	582	0.34
Right							
Northbound							
Prot							
Perm							
Left	L	6	496	0.01	0.42	207	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	796	4895	# 0.16	0.42	2040	0.39
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.68

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.96	0.42	17.0	1.000	606	0.50	27.5	0.0	44.5	D			
LT	0.34	0.42	11.9	1.000	582	0.50	1.5	0.0	13.4	B	36.7	D	
Northbound													
L	0.03	0.42	10.3	1.000	207	0.50	0.2	0.0	10.6	B	10.6	B	
Southbound													
LTR	0.39	0.42	12.2	1.000	2040	0.50	0.6	0.0	12.8	B	12.8	B	

Intersection delay = 24.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		582	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		4	796	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		9.70	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	4.87	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.32	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	20.68	
n=Max(gq-gf)/2,0)		0.00	2.16	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.96	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.11	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	4.32	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.28	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.280	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	194		
Proportion of LT in LT lane group, PLT	0.000	0.990	0.039
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.23		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		582	196	6		292	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1454	1398	496		1796	
LnCapacity	784		606	582	207		748	
Flow Ratio	0.0		0.4	0.1	0.0		0.2	
v/c Ratio	0.01		0.96	0.34	0.03		0.39	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.971		0.951	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		9.4	2.2	0.1		3.4	
kB	0.7		0.6	0.6	0.3		0.7	
Q2	0.0		5.2	0.3	0.0		0.4	
Q Average	0.0		14.6	2.5	0.1		3.8	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	0.1		17.7	3.2	0.1		4.8	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7		1.5	
BOQ	0.1		20.7	4.0	0.1		5.9	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0		1.7	
BOQ	0.1		22.4	4.5	0.1		6.6	
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	2.2	2.6		2.1	
BOQ	0.1		24.2	5.5	0.2		7.9	
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2		2.4	
BOQ	0.1		26.1	6.5	0.2		9.2	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Englewood Ave & Vets Rd W RT
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Englewood Avenue
North/South Street: Veterans Rd W Right Turn Bay
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1	2	3	4	5	6
		L	T	R	L	T	R

Volume	29				
Peak-Hour Factor, PHF	0.69				
Hourly Flow Rate, HFR	42				
Percent Heavy Vehicles	--	--		--	--
Median Type/Storage	Undivided		/		
RT Channelized?					
Lanes	1				
Configuration	T				
Upstream Signal?	No			No	

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R

Volume	590		
Peak Hour Factor, PHF	0.88		
Hourly Flow Rate, HFR	670		
Percent Heavy Vehicles	0		
Percent Grade (%)	0		0
Flared Approach: Exists?/Storage		/	/
Lanes	1		
Configuration	R		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			

v (vph)	670
C(m) (vph)	1034
v/c	0.65
95% queue length	4.98
Control Delay	14.6
LOS	B
Approach Delay	14.6
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		29				
Peak-Hour Factor, PHF		0.69				
Peak-15 Minute Volume		11				
Hourly Flow Rate, HFR		42				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			590			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			168			
Hourly Flow Rate, HFR			670			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					42			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	42	
Potential Capacity	1034	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1034	
Probability of Queue free St.	0.35	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.35
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.35
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			670			
Movement Capacity (vph)			1034			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1034			
Volume			670			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					670			
C(m) (vph)					1034			
v/c					0.65			
95% queue length					4.98			
Control Delay					14.6			
LOS					B			
Approach Delay				14.6				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	77	35	260	60	0	0	0	0	17	119	23
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.75		0.85				0.89 0.89	
Flow Rate	148		375				85 92	
% Heavy Veh	2		4				0 0	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	148		375				85	92
Left-Turn	0		305				19	0
Right-Turn	46		0				0	25
Prop. Left-Turns	0.0		0.8				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 No-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	26	68	0	0	266	24	53	106	138	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	124		340		110		200	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	124		340		110	200		
Left-Turn	34		0		55	0		
Right-Turn	0		28		0	145		
Prop. Left-Turns	0.3		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	-0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	124		340		110	200		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.11		0.30		0.10	0.18		
hd, final value	5.16		4.78		5.18	4.64		
x, final value	0.18		0.45		0.16	0.26		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.2		2.8		3.2	2.6		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	124		340		110	200		
Service Time	3.2		2.8		3.2	2.6		
Utilization, x	0.18		0.45		0.16	0.26		
Dep. headway, hd	5.16		4.78		5.18	4.64		
Capacity	374		590		360	450		
Delay	9.27		11.65		9.15	9.24		
LOS	A		B		A	A		
Approach:								
Delay		9.27		11.65		9.20		
LOS		A		B		A		
Intersection Delay	10.29							
			Intersection		LOS	B		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	217	261	142	0	63	15	644	65	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	551	1573	1.16	0.35	108.7	F	95.8	F
R	560	1599	0.18	0.35	14.2	B		

Westbound

LTR	558	1593	0.17	0.35	14.1	B	14.1	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2267	4690	0.34	0.48	10.0-	A	10.0-	A
-----	------	------	------	------	-------	---	-------	---

Southbound

Intersection Delay = 49.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	217	261	142	0	63	15	644	65	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	72	87	47	0	19	5	173	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		637	101		94			765				
%InSharedLn												
Prop LTs		0.454			0.000			0.905				
Prop RTs		0.000	1.000		0.191			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	217	261	142	0	63	15	644	65	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	289	348	101	0	76	18	692	70	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		637	101		94			765				
Prop LTs		0.454			0.000			0.905				
Prop RTs		0.000	1.000		0.191			0.004				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.990	0.990	1.000		0.980			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.974		0.999			
fLT	0.809		1.000		0.957			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1573	1599	1593		4690			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.16	0.35	19.5	1.000	551	0.50	89.2	0.0	108.7	F	95.8	F
R	0.18	0.35	13.5	1.000	560	0.50	0.7	0.0	14.2	B		
Westbound												
LTR	0.17	0.35	13.5	1.000	558	0.50	0.6	0.0	14.1	B	14.1	B
Northbound												
LTR	0.34	0.48	9.6	1.000	2267	0.50	0.4	0.0	10.0-	A	10.0-	A
Southbound												

Intersection delay = 49.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	289	0	
Proportion of LT in LT lane group, PLT	0.454	0.000	0.905
Proportion of LT in opposing flow, PLTo	0.00	0.45	
Adjusted opposing flow rate, Vo (veh/h)	94	637	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.82	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.57	10.62	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	13.94	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	7.06	
n=Max(gq-gf)/2,0)	0.00	6.97	
PTHo=1-PLTo	1.00	0.55	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.45	0.00	
EL1 (refer to Exhibit C16-3)	1.52	2.63	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.17	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	13.94	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.34	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.809	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	13.94		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.664		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	94	637	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.454	0.000	0.905	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.191	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	21.5	0.0	108.7
R	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.6	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	

Intersection Delay	49.9	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	637	101	94	280			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1573	1599	1593	1721			
LnCapacity	551	560	558	832			
Flow Ratio	0.4	0.1	0.1	0.2			
v/c Ratio	1.16	0.18	0.17	0.34			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.997		0.993	0.967			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	10.6	1.2	1.1	2.9			
kB	0.6	0.6	0.6	0.7			
Q2	14.0	0.1	0.1	0.4			
Q Average	24.6	1.3	1.2	3.2			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	29.5	1.7	1.5	4.1			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.6			
BOQ	34.5	2.1	2.0	5.1			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.9	1.9	1.8			
BOQ	37.0	2.4	2.3	5.7			
QSRatio							
95th Percentile Output:							
fB%	1.6	2.4	2.4	2.1			
BOQ	39.5	3.1	2.9	6.9			
QSRatio							
98th Percentile Output:							
fB%	1.7	2.9	2.9	2.5			
BOQ	42.1	3.7	3.4	8.1			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	208		56				17	402		382	61	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	465	1743	0.62	0.27	25.0	C	25.0	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1111	1961	0.41	0.57	8.4	A	8.4	A
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Southbound

TR	1185	2092	0.41	0.57	8.3	A	8.3	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 12.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	208		56				17	402		382	61	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
PK 15 Vol	57		15				5	109		105	17	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		287						455			487	
%InSharedLn												
Prop LTs		0.787						0.040			0.000	
Prop RTs		0.213						0.000			0.138	
Peds Bikes	0			0						0		0
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.937						0.937			0.937	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	208		56				17	402		382	61	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
Adj flow	226		61				18	437		420	67	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		287						455			487	
Prop LTs		0.787						0.040			0.000	
Prop RTs	0.213						0.000			0.138		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.971						1.000			0.981		
fLT	0.962						0.977			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1743						1961			2092		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	287	1743	# 0.16	0.27	465	0.62
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	455	1961	0.23	0.57	1111	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	487	2092	# 0.23	0.57	1185	0.41
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.40$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.48$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.62	0.27	19.3	1.000	465	0.50	5.7	0.0	25.0	C	25.0	C
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1111	0.50	1.0	0.0	8.4	A	8.4	A
Southbound												
TR	0.41	0.57	7.3	1.000	1185	0.50	1.0	0.0	8.3	A	8.3	A

Intersection delay = 12.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.787	0.040	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		487	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.12	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		5.04	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.27	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.977	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.04	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.148	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			487	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.040	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.138
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.3	0.00	0.0	0.0	25.0
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.3
	0.0						0.0	
Intersection Delay			12.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	287						455			487		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1743						1961			2092		
LnCapacity	465						1111			1185		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.62						0.41			0.41		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.937						0.937			0.937		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.2						4.3			4.6		
kB	0.5						0.9			0.9		
Q2	0.7						0.6			0.6		
Q Average	4.9						4.9			5.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.1						6.0			6.4		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	7.5						7.4			7.9		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.7			1.7		
BOQ	8.3						8.2			8.7		
QSRatio												
95th Percentile Output:												
fB%	2.0						2.0			2.0		
BOQ	9.7						9.6			10.2		
QSRatio												
98th Percentile Output:												
fB%	2.3						2.3			2.2		
BOQ	11.1						11.0			11.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	141		66				43	504		386	247	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								20	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0					30.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	575	1726	0.48	0.33	18.5	B	18.5	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	840	1679	0.71	0.50	15.9	B	15.9	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	1013	2026	0.66	0.50	14.3	B	14.3	B
----	------	------	------	------	------	---	------	---

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	141		66				43	504		386	247	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	47		22				12	137		106	68	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		276						595			673	
%InSharedLn												
Prop LTs		0.681						0.079			0.000	
Prop RTs	0.319						0.000			0.370		
Peds Bikes	0	0		0						0	0	
Buses	0						0			0		
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	141		66				43	504		386	247	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	188		88				47	548		424	249	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		276						595			673	
Prop LTs		0.681						0.079			0.000	
Prop RTs		0.319						0.000			0.370	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.957						1.000			0.950		
fLT	0.967						0.900			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1726						1679			2026		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	276	1726	# 0.16	0.33	575	0.48
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	595	1679	# 0.35	0.50	840	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	673	2026	0.33	0.50	1013	0.66
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.48	0.33	15.9	1.000	575	0.50	2.7	0.0	18.5	B	18.5	B
Westbound												
Northbound												
LT	0.71	0.50	11.6	1.000	840	0.50	4.3	0.0	15.9	B	15.9	B
Southbound												
TR	0.66	0.50	11.2	1.000	1013	0.50	3.1	0.0	14.3	B	14.3	B

Intersection delay = 15.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		47	
Proportion of LT in LT lane group, PLT	0.681	0.079	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		673	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.78	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.22	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		9.95	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.05	
n=Max(gq-gf)/2,0)		0.30	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.08	
EL1 (refer to Exhibit C16-3)		2.72	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.90	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.900	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			9.95	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.332	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		673	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.681		0.079	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.319	0.370
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	15.9	0.00	0.0	0.0 0.0 0.0	18.5
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	11.6	0.00	0.0	0.0 0.0 0.0	15.9
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	11.2	0.00	0.0	0.0 0.0 0.0	14.3
Intersection Delay			15.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	276						595			673		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1726						1679			2026		
LnCapacity	575						840			1013		
Flow Ratio	0.2						0.4			0.3		
v/c Ratio	0.48						0.71			0.66		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.7						7.7			8.4		
kB	0.5						0.6			0.8		
Q2	0.5						1.5			1.5		
Q Average	4.1						9.2			9.9		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.2						11.2			12.0		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.3						13.3			14.3		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.1						14.5			15.5		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.7		
BOQ	8.4						16.1			17.2		
QSRatio												
98th Percentile Output:												
fB%	2.4						1.9			1.9		
BOQ	9.8						17.8			18.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		122	301	614	173	81	228		420		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.12	0.13	23.7	C	40.3	D
R	220	1652	0.78	0.13	43.0	D		
Westbound								
LTR	1338	4723	0.93	0.28	28.4	C	28.4	C
Northbound								
L	139	416	0.63	0.33	35.3	D		
T	621	1863	0.40	0.33	17.1	B	21.9	C
Southbound								
TR	707	2121	0.69	0.33	21.4	C	21.4	C

Intersection Delay = 27.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		122	301	614	173	81	228		420	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		43	86	176	50	22	62		117	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		172		1251		88	248			486	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000		0.039		
Peds Bikes	0			0	0					0	0	
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		122	301	614	173	81	228		420	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		172	346	706	199	88	248		467	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	27		172		1251		88	248			486	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000			0.039	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.980	0.980	0.990	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	1.000	1.000	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.976			1.000	0.995	
fLT	0.950		0.986		0.223	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4723		416	1863	2121	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.13	222	0.12
Prot							
Perm							
Thru							
Right	R	172	1652	# 0.10	0.13	220	0.78
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1251	4723	# 0.26	0.28	1338	0.93
Right							
Northbound							
Prot							
Perm							
Left	L	88	416	0.21	0.33	139	0.63
Prot							
Perm							
Thru	T	248	1863	0.13	0.33	621	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	486	2121	# 0.23	0.33	707	0.69
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.12	0.13	22.9	1.000	222	0.50	0.8	0.0	23.7	C	40.3	D	
R	0.78	0.13	25.2	1.000	220	0.50	17.8	0.0	43.0	D			
Westbound													
LTR	0.93	0.28	21.0	1.000	1338	0.50	7.4	0.0	28.4	C	28.4	C	
Northbound													
L	0.63	0.33	16.9	1.000	139	0.50	18.4	0.0	35.3	D	21.9	C	
T	0.40	0.33	15.4	1.000	621	0.50	1.8	0.0	17.1	B			
Southbound													
TR	0.69	0.33	17.3	1.000	707	0.50	4.1	0.0	21.4	C	21.4	C	

Intersection delay = 27.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			88	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			486	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.47	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.10	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			10.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.17	
n=Max(gq-gf)/2,0)			5.41	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.06	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.22	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.223	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 PTHo=1-PLTo
 $PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N-1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.83	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.541	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			486	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)		17.0		20.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		17.0		20.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.159	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.7
	0.0						0.0	
R	0.0	0.00	26.0	25.2	0.00	0.0	0.0	43.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	21.0	0.00	0.0	0.0	28.4
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.9	0.00	0.0	0.0	35.3
T	0.0	0.00	20.0	15.4	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	17.3	0.00	0.0	0.0	21.4
	0.0						0.0	
Intersection Delay			27.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	27	172		459		88	248		486
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1733		416	1863		2121
LnCapacity	222	220		491		139	621		707
Flow Ratio	0.0	0.1		0.3		0.2	0.1		0.2
v/c Ratio	0.12	0.78		0.93		0.63	0.40		0.69
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.717		0.483			0.917		0.747
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.4	2.8		7.5		1.2	3.2		7.0
kB	0.2	0.2		0.3		0.2	0.6		0.5
Q2	0.0	0.7		2.3		0.3	0.4		1.1
Q Average	0.4	3.5		9.8		1.6	3.6		8.1
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.2		1.2
BOQ	0.6	4.3		11.8		2.0	4.4		9.8
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.4		1.6	1.5		1.5
BOQ	0.7	5.4		14.1		2.5	5.5		11.8
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.7		1.6
BOQ	0.8	6.1		15.3		2.9	6.2		12.9
QSRatio									
95th Percentile Output:									
fB%	2.5	2.1		1.7		2.3	2.1		1.8
BOQ	1.1	7.3		17.0		3.6	7.4		14.5
QSRatio									
98th Percentile Output:									
fB%	3.1	2.5		1.9		2.8	2.4		2.0
BOQ	1.3	8.5		18.7		4.4	8.7		16.1
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	31	33	5				3	278	152	314	480	47
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.20 0.28 17.3 B 17.3 B

Westbound

Northbound

LTR 966 1756 0.49 0.55 9.9 A 9.9 A

Southbound

L 494 898 0.71 0.55 15.4 B
 TR 1024 1861 0.56 0.55 10.2 B 12.2 B

Intersection Delay = 11.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	31	33	5				3	278	152	314	480	47
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	11	2				1	76	41	87	133	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		91						470		349	573	
%InSharedLn												
Prop LTs		0.451						0.006		1.000	0.000	
Prop RTs		0.077						0.351			0.070	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	31	33	5				3	278	152	314	480	47
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	41	43	7				3	302	165	349	533	40
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	91						470			349	573	
Prop LTs	0.451						0.006			1.000	0.000	
Prop RTs	0.077						0.351			0.070		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.990	0.990	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							1.000			1.000	1.000	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.990							0.953				0.990	
fLT	0.978							0.998			0.477	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1630							1756			898	1861	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	91	1630	# 0.06	0.28	462	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	470	1756	0.27	0.55	966	0.49
Right							
Southbound							
Prot							
Perm							
Left	L	349	898	# 0.39	0.55	494	0.71
Prot							
Perm							
Thru	TR	573	1861	0.31	0.55	1024	0.56
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.53

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.20	0.28	16.3	1.000	462	0.50	1.0	0.0	17.3	B	17.3	B
Westbound												
Northbound												
LTR	0.49	0.55	8.3	1.000	966	0.50	1.6	0.0	9.9	A	9.9	A
Southbound												
L	0.71	0.55	9.9	1.000	494	0.50	5.4	0.0	15.4	B		
TR	0.56	0.55	8.8	1.000	1024	0.50	1.4	0.0	10.2	B	12.2	B

Intersection delay = 11.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				349
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				470
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.82
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.83
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				5.17
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.83
n=Max(gq-gf)/2,0)				2.58
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.03
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.57
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				5.17
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.48
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.477

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.451
Proportion of LT in opposing flow, PLTo	0.006 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	573
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	6.83
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.47
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.83	5.17
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.207	0.157
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			573	470
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.006	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.077	0.351	0.070
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	9.9
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.9	0.00	0.0	0.0	15.4
TR	0.0	0.00	13.5	8.8	0.00	0.0	0.0	10.2
	0.0						0.0	

Intersection Delay	11.7	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		91						470			349	573
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1630						1756			898	1861
LnCapacity		462						966			494	1024
Flow Ratio		0.1						0.3			0.4	0.3
v/c Ratio		0.20						0.49			0.71	0.56
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.899				0.644
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		1.2						4.8			4.3	6.2
kB		0.5						0.8			0.3	0.6
Q2		0.1						0.7			0.8	0.7
Q Average		1.3						5.5			5.1	6.9
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.6						6.8			6.3	8.5
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		2.1						8.3			7.6	10.2
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		2.4						9.2			8.5	11.2
QSRatio												
95th Percentile Output:												
fB%		2.4						1.9			2.0	1.9
BOQ		3.0						10.7			9.9	12.8
QSRatio												
98th Percentile Output:												
fB%		2.9						2.2			2.2	2.1
BOQ		3.6						12.1			11.4	14.4
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	8	18	293	18	105	13	278	241	86	386	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 631 1420 0.06 0.44 14.5 B 14.5 B

Westbound

L 578 1301 0.56 0.44 22.0 C
 T 808 1818 0.02 0.44 14.1 B 20.1 C
 R 601 1352 0.19 0.44 15.8 B

Northbound

LTR 735 1654 0.79 0.44 25.8 C 25.8 C

Southbound

LTR 620 1396 0.86 0.44 30.5 C 30.5 C

Intersection Delay = 25.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	8	18	293	18	105	13	278	241	86	386	8
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	81	5	29	4	76	65	24	107	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		41		326	20	117		578			534	
%InSharedLn												
Prop LTs		0.244		1.000	0.000			0.024			0.180	
Prop RTs		0.512			0.000	1.000		0.453			0.017	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	8	18	293	18	105	13	278	241	86	386	8
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	10	10	21	326	20	117	14	302	262	96	429	9
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	41			326	20	117	578			534		
Prop LTs	0.244			1.000	0.000		0.024			0.180		
Prop RTs	0.512			0.000 1.000			0.453			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.980			0.990	0.990	0.990	1.000			0.990		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	1.000			1.000	1.000	1.000	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.931			1.000 0.850			0.939			0.998		
fLT	0.964			0.730 1.000			0.984			0.747		
Sec.												
fLpb	1.000			0.947 1.000			1.000			0.996		
fRpb	0.971			1.000 1.000			0.975			1.000		
S	1420			1301 1818 1352			1654			1396		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1420	0.03	0.44	631	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	326	1301	# 0.25	0.44	578	0.56
Prot							
Perm							
Thru	T	20	1818	0.01	0.44	808	0.02
Right	R	117	1352	0.09	0.44	601	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	578	1654	0.35	0.44	735	0.79
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	534	1396	# 0.38	0.44	620	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.06	0.44	14.3	1.000	631	0.50	0.2	0.0	14.5	B	14.5	B	
Westbound													
L	0.56	0.44	18.5	1.000	578	0.50	3.5	0.0	22.0	C			
T	0.02	0.44	14.0	1.000	808	0.50	0.1	0.0	14.1	B	20.1	C	
R	0.19	0.44	15.2	1.000	601	0.50	0.6	0.0	15.8	B			
Northbound													
LTR	0.79	0.44	21.4	1.000	735	0.50	4.4	0.0	25.8	C	25.8	C	
Southbound													
LTR	0.86	0.44	22.5	1.000	620	0.50	8.0	0.0	30.5	C	30.5	C	

Intersection delay = 25.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		326		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.24		
Adjusted opposing flow rate, Vo (veh/h)		41		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		8.15		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.02		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.76		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.730		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	14	96
Proportion of LT in LT lane group, PLT	0.244	0.000	0.024
Proportion of LT in opposing flow, PLTo	0.00	0.18	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	534	578
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.35	2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	13.35	14.45
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	20.6	4.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.09	15.28
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	19.35	24.72
n=Max(gq-gf)/2,0)	0.00	0.00	5.64
PTHo=1-PLTo	1.00	0.82	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.24	0.02	0.18
EL1 (refer to Exhibit C16-3)	1.40	2.38	2.48
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.33
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	11.27
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96	0.98	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.964	0.984	0.747

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.09	15.28
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.352	0.382
OCCpedu	0.000	0.056	0.000	0.045
Opposing flow rate, Vo (veh/h)	20	41	534	578
OCCr	0.000	0.053	0.000	0.020
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.980
Proportion of left turns, PLT	0.244	1.000	0.024	0.180
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.512	1.000	0.453	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.975	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.5
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.5	0.00	0.0	0.0	22.0
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.4	0.00	0.0	0.0	25.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	22.5	0.00	0.0	0.0	30.5
	0.0						0.0	
Intersection Delay			25.4	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		41	326	20	117		578		534
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1420	1301	1818	1352		1654		1396
LnCapacity		631	578	808	601		735		620
Flow Ratio		0.0	0.3	0.0	0.1		0.3		0.4
v/c Ratio		0.06	0.56	0.02	0.19		0.79		0.86
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.887			0.516		0.500
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.6	6.0	0.3	1.8		12.3		12.0
kB		0.8	0.7	0.9	0.7		0.5		0.4
Q2		0.1	0.9	0.0	0.2		1.6		2.1
Q Average		0.6	6.9	0.3	1.9		14.0		14.1
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.8	8.5	0.4	2.5		16.8		17.0
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.1	10.2	0.5	3.1		19.8		20.0
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.2	11.2	0.6	3.6		21.4		21.6
QSRatio									
95th Percentile Output:									
fB%		2.5	1.9	2.5	2.3		1.7		1.7
BOQ		1.6	12.8	0.8	4.4		23.2		23.5
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.8		1.8
BOQ		1.9	14.4	0.9	5.3		25.0		25.3
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	185	239		170	184		151		134			
Lane Width	16.0			16.0			11.0					
RTOR Vol		56						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR 977 1953 0.48 0.50 16.4 B 16.4 B

Westbound

LT 498 995 0.80 0.50 31.3 C 31.3 C

Northbound

LR 565 1452 0.59 0.39 26.2 C 26.2 C

Southbound

Intersection Delay = 24.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 No-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		185	239	170	184		151		134			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		59	77	48	52		44		39			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		472			398			336				
%InSharedLn												
Prop LTs		0.000			0.480			0.530				
Prop RTs		0.498			0.000			0.470				
Peds Bikes	0						0			0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		185	239	170	184		151		134			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		237	235	191	207		178		158			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		472			398			336				
Prop LTs		0.000			0.480			0.530				
Prop RTs		0.498			0.000			0.470				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.933			1.000			0.937					
fLT	1.000			0.481			0.974					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1953			995			1452					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	472	1953	0.24	0.50	977	0.48
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	398	995	# 0.40	0.50	498	0.80
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	336	1452	# 0.23	0.39	565	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.48	0.50	14.8	1.000	977	0.50	1.6	0.0	16.4	B	16.4	B
Westbound												
LT	0.80	0.50	18.7	1.000	498	0.50	12.5	0.0	31.3	C	31.3	C
Northbound												
LR	0.59	0.39	21.9	1.000	565	0.50	4.4	0.0	26.2	C	26.2	C
Southbound												

Intersection delay = 24.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	191		
Proportion of LT in LT lane group, PLT	0.000	0.480	0.530
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	472		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.80		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	10.54		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.46		
n=Max(gq-gf)/2,0)	5.27		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.48		
EL1 (refer to Exhibit C16-3)	2.24		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.48		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.481		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.8	0.00	0.0	0.0	16.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	18.7	0.00	0.0	0.0	31.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	21.9	0.00	0.0	0.0	26.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			24.0	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		472			398			336				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1953			995			1452				
LnCapacity		977			498			565				
Flow Ratio		0.2			0.4			0.2				
v/c Ratio		0.48			0.80			0.59				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		7.8			8.3			6.7				
kB		1.0			0.7			0.7				
Q2		1.0			2.3			1.0				
Q Average		8.7			10.6			7.7				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		10.6			12.9			9.4				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.5				
BOQ		12.7			15.2			11.3				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.6			1.6				
BOQ		13.9			16.6			12.4				
QSRatio												
95th Percentile Output:												
fB%		1.8			1.7			1.8				
BOQ		15.5			18.3			14.0				
QSRatio												
98th Percentile Output:												
fB%		2.0			1.9			2.0				
BOQ		17.1			20.0			15.6				
QSRatio												

ERROR MESSAGES

No errors to report.

With-Action 2015

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	8	7	7	60	9	27	26	146	41	28	151	37
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 179 1533 0.16 0.12 25.7 C 25.7 C

Westbound

LTR 478 1913 0.21 0.25 18.8 B 18.8 B

Northbound

LTR 621 1620 0.41 0.38 15.6 B 15.6 B

Southbound

LTR 658 1716 0.40 0.38 15.2 B 15.2 B

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	7	7	60	9	27	26	146	41	28	151	37
% Heavy Veh	32	32	32	5	5	5	20	20	20	13	13	13
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	3	2	2	16	3	7	8	44	12	8	45	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			100			256			261	
%InSharedLn												
Prop LTs		0.357			0.630			0.121			0.130	
Prop RTs		0.321			0.280			0.191			0.172	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			4			4	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	7	7	60	9	27	26	146	41	28	151	37
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	10	9	9	63	9	28	31	176	49	34	182	45
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	28			100			256			261		
Prop LTs	0.357			0.630			0.121			0.130		
Prop RTs	0.321			0.280			0.191			0.172		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.758			0.952			0.833			0.885		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.984			0.984		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.957			0.962			0.974			0.977		
fLT	0.982			0.969			0.942			0.937		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1533			1913			1620			1716		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1533	# 0.02	0.12	179	0.16
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	100	1913	# 0.05	0.25	478	0.21
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	256	1620	# 0.16	0.38	621	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	261	1716	0.15	0.38	658	0.40
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.23
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.30

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.16	0.12	23.8	1.000	179	0.50	1.9	0.0	25.7	C	25.7	C	
Westbound													
LTR	0.21	0.25	17.8	1.000	478	0.50	1.0	0.0	18.8	B	18.8	B	
Northbound													
LTR	0.41	0.38	13.5	1.000	621	0.50	2.0	0.0	15.6	B	15.6	B	
Southbound													
LTR	0.40	0.38	13.5	1.000	658	0.50	1.8	0.0	15.2	B	15.2	B	

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			31	34
Proportion of LT in LT lane group, PLT	0.357	0.630	0.121	0.130
Proportion of LT in opposing flow, PLTo			0.13	0.12
Adjusted opposing flow rate, Vo (veh/h)			261	256
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.52	0.57
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.35	4.27
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			8.0	7.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			4.07	3.94
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.96	15.40
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.87	0.88
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.12	0.13
EL1 (refer to Exhibit C16-3)			1.81	1.80
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.942	0.937

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET				
Permitted Left Turns				
	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				3.94
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.171
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				256
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.130
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.321	0.191
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	23.8	0.00	0.0	0.0	25.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.8	0.00	0.0	0.0	18.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.5	0.00	0.0	0.0	15.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.5	0.00	0.0	0.0	15.2
	0.0						0.0	
Intersection Delay			16.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			LTR			LTR			LTR		
Init Queue	0.0			0.0			0.0			0.0		
Flow Rate	28			100			256			261		
So	1900			1900			1900			1900		
No.Lanes	0	1	0	0	1	0	0	1	0	0	1	0
SL	1533			1913			1620			1716		
LnCapacity	179			478			621			658		
Flow Ratio	0.0			0.1			0.2			0.2		
v/c Ratio	0.16			0.21			0.41			0.40		
Grn Ratio	0.12			0.25			0.38			0.38		
I Factor	1.000			1.000			1.000			1.000		
AT or PVG	3			3			3			3		
Pltn Ratio	1.00			1.00			1.00			1.00		
PF2	1.00			1.00			1.00			1.00		
Q1	0.4			1.3			3.1			3.2		
kB	0.3			0.5			0.6			0.6		
Q2	0.0			0.1			0.4			0.4		
Q Average	0.5			1.5			3.6			3.6		
Q Spacing	25.0			25.0			25.0			25.0		
Q Storage	0			0			0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.3			1.2			1.2		
BOQ	0.6			1.9			4.4			4.5		
QSRatio												
85th Percentile Output:												
fB%	1.7			1.6			1.5			1.5		
BOQ	0.8			2.4			5.5			5.5		
QSRatio												
90th Percentile Output:												
fB%	2.0			1.9			1.7			1.7		
BOQ	0.9			2.7			6.2			6.2		
QSRatio												
95th Percentile Output:												
fB%	2.5			2.3			2.1			2.1		
BOQ	1.2			3.4			7.4			7.5		
QSRatio												
98th Percentile Output:												
fB%	3.1			2.8			2.4			2.4		
BOQ	1.4			4.1			8.7			8.7		
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			197	31		20	199	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			237	37		24	239	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		7		16				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		10		23				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		24			33					
C(m) (vph)		1239			668					
v/c		0.02			0.05					
95% queue length		0.06			0.16					
Control Delay		8.0			10.7					
LOS		A			B					
Approach Delay					10.7					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		197	31	20	199	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		59	9	6	60	
Hourly Flow Rate, HFR		237	37	24	239	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	7		16			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	10		23			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		239
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		274	543		256			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	256	
Potential Capacity	788	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	788	
Probability of Queue free St.	0.97	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	274	
Potential Capacity	1239	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1239	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	543	
Potential Capacity	504	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.95
Movement Capacity	494	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 543
Potential Capacity 504
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.95
Movement Capacity 494

Results for Two-stage process:

a
y
C t 494

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	10		23			
Movement Capacity (vph)	494		788			
Shared Lane Capacity (vph)		668				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	494		788			
Volume	10		23			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		668				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		24		33				
C(m) (vph)		1239		668				
v/c		0.02		0.05				
95% queue length		0.06		0.16				
Control Delay		8.0		10.7				
LOS		A		B				
Approach Delay				10.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		239
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	263	33	265	0	139	284	86	112	8
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	710	1703	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	531	1274	0.64	0.42	19.4	B	18.9	B
R	514	1233	0.59	0.42	18.2	B		

Northbound

LTR	702	1685	0.71	0.42	19.8	B	19.8	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	416	998	0.57	0.42	19.0	B	19.0	B
-----	-----	-----	------	------	------	---	------	---

Intersection Delay = 19.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	263	33	265	0	139	284	86	112	8
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	76	9	76	0	41	84	25	32	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			340	305		498			237	
%InSharedLn												
Prop LTs		0.273			0.888			0.000			0.418	
Prop RTs		0.091			0.000	1.000		0.671			0.038	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	263	33	265	0	139	284	86	112	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	302	38	305	0	164	334	99	129	9
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			340 305			498			237		
Prop LTs	0.273			0.888			0.000			0.418		
Prop RTs	0.091			0.000 1.000			0.671			0.038		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.909			0.995		
fLT	0.938			0.742			1.000			0.523		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1703			1274 1233			1685			998		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1703	0.01	0.42	710	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	340	1274	# 0.27	0.42	531	0.64
Right	R	305	1233	0.25	0.42	514	0.59
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	498	1685	# 0.30	0.42	702	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	237	998	0.24	0.42	416	0.57
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	710	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.64	0.42	13.9	1.000	531	0.50	5.5	0.0	19.4	B	18.9	B
R	0.59	0.42	13.6	1.000	514	0.50	4.7	0.0	18.2	B		
Northbound												
LTR	0.71	0.42	14.5	1.000	702	0.50	5.3	0.0	19.8	B	19.8	B
Southbound												
LTR	0.57	0.42	13.4	1.000	416	0.50	5.6	0.0	19.0	B	19.0	B

Intersection delay = 19.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	302	0	99
Proportion of LT in LT lane group, PLT	0.273	0.888	0.000	0.418
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	340	11	237	498
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.03	0.00	1.65
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.67	0.18	3.95	8.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	2.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.46	0.00	2.95	8.99
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	22.05	16.01
n=Max(gq-gf)/2,0)	0.00	0.00	1.47	3.15
PTHo=1-PLTo	0.11	0.73	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.42
EL1 (refer to Exhibit C16-3)	1.96	1.39	1.76	2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.32	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	2.95	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.52
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.938	0.742	1.000	0.523

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.46			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.219			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	340			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.9	0.00	0.0	0.0	19.4
R	0.0	0.00	17.5	13.6	0.00	0.0	0.0	18.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.5	0.00	0.0	0.0	19.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.4	0.00	0.0	0.0	19.0
	0.0						0.0	
Intersection Delay			19.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	11			340	305	498			237			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1703			1274	1233	1685			998			
LnCapacity	710			531	514	702			416			
Flow Ratio	0.0			0.3	0.2	0.3			0.2			
v/c Ratio	0.02			0.64	0.59	0.71			0.57			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.940		0.887			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			4.5	3.9	6.9			3.0			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			0.9	0.7	1.4			0.6			
Q Average	0.1			5.4	4.7	8.3			3.6			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			6.7	5.8	10.1			4.5			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.5			
BOQ	0.2			8.1	7.1	12.0			5.6			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.7	1.7	1.6			1.7			
BOQ	0.2			9.0	7.9	13.2			6.3			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.9	2.0	1.8			2.1			
BOQ	0.3			10.5	9.3	14.8			7.5			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.2	2.3	2.0			2.4			
BOQ	0.4			11.9	10.7	16.4			8.8			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				156		5		419			376	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 631 1893 0.29 0.33 15.8 B 15.8 B

Northbound

T 970 1940 0.51 0.50 11.7 B 11.7 B

Southbound

T 925 1850 0.47 0.50 11.1 B 11.1 B

Intersection Delay = 12.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				156		5	419			376		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				44		2	123			108		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					183		493			432		
%InSharedLn												
Prop LTs					0.967		0.000			0.000		
Prop RTs					0.033		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination	1	2	3	4	5	6	7	8
EB Left Thru Right Peds					NB Left Thru Right Peds	P		
WB Left Thru Right Peds	P				SB Left Thru Right Peds	P		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				156		5	419			376		
PHF				0.88		0.88	0.85			0.87		
Adj flow				177		6	493			432		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					183			493			432	
Prop LTs					0.967			0.000			0.000	
Prop RTs					0.033			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.996			1.000			1.000	
fLT					0.954			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1893			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	183	1893	# 0.10	0.33	631	0.29
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	493	1940	# 0.25	0.50	970	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	432	1850	0.23	0.50	925	0.47
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.29	0.33	14.8	1.000	631	0.50	1.0	0.0	15.8	B	15.8	B
Northbound												
T	0.51	0.50	10.1	1.000	970	0.50	1.7	0.0	11.7	B	11.7	B
Southbound												
T	0.47	0.50	9.8	1.000	925	0.50	1.3	0.0	11.1	B	11.1	B

Intersection delay = 12.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.967 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	15.8
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.1	0.00	0.0	0.0	11.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.8	0.00	0.0	0.0	11.1
	0.0						0.0	
Intersection Delay			12.1	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			419	216		116	416	
Peak-Hour Factor, PHF			0.85	0.85		0.87	0.87	
Hourly Flow Rate, HFR			492	254		133	478	
Percent Heavy Vehicles			--	--		20	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/			/
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		133						
C(m) (vph)		786						
v/c		0.17						
95% queue length		0.61						
Control Delay		10.5						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		419	216	116	416	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		123	64	33	120	
Hourly Flow Rate, HFR		492	254	133	478	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		478
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		746						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	746	
Potential Capacity	786	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	786	
Probability of Queue free St.	0.83	1.00
Maj L-Shared Prob Q free St.	0.76	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.76	0.76
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.83	0.83
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.76 0.76
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.83 0.83
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R

Volume (vph)
Movement Capacity (vph)
Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		133						
C(m) (vph)		786						
v/c		0.17						
95% queue length		0.61						
Control Delay		10.5						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.83
v(il), Volume for stream 2 or 5		478
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.76
d(M,LT), Delay for stream 1 or 4		10.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.5

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				58		136	497	72		89	320	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR	384	1440	0.54	0.27	24.2	C	24.2	C
----	-----	------	------	------	------	---	------	---

Northbound

TR	1032	1821	0.65	0.57	11.4	B	11.4	B
----	------	------	------	------	------	---	------	---

Southbound

LT	768	1355	0.61	0.57	11.7	B	11.7	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 13.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				58		136	497	72		89	320	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				16		37	146	21		26	92	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					208			670			470	
%InSharedLn												
Prop LTs					0.298			0.000			0.217	
Prop RTs					0.702			0.127			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				58		136	497	72		89	320	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				62		146	585	85		102	368	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					208			670			470	
Prop LTs					0.298			0.000			0.217	
Prop RTs					0.702			0.127			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.901			0.917	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.905			0.983			1.000	
fLT					0.985			1.000			0.715	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1440			1821			1355	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	208	1440	# 0.14	0.27	384	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	670	1821	# 0.37	0.57	1032	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	470	1355	0.35	0.57	768	0.61
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.54	0.27	18.9	1.000	384	0.50	5.3	0.0	24.2	C	24.2	C	
Northbound													
TR	0.65	0.57	8.9	1.000	1032	0.50	2.4	0.0	11.4	B	11.4	B	
Southbound													
LT	0.61	0.57	8.6	1.000	768	0.50	3.1	0.0	11.7	B	11.7	B	

Intersection delay = 13.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			102
Proportion of LT in LT lane group, PLT	0.298	0.000	0.217
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			670
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			1.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.17
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			5.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			7.80
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.20
n=Max(gq-gf)/2,0)			1.28
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.22
EL1 (refer to Exhibit C16-3)			2.72
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.715

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.80
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.229
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				670
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.217
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCcr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.702	0.127
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.9	0.00	0.0	0.0	24.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.9	0.00	0.0	0.0	11.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	8.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Intersection Delay			13.4	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR		LT
Init Queue					0.0		0.0		0.0
Flow Rate					208		670		470
So					1900		1900		1900
No.Lanes	0	0	0	0	0	0	1	0	1
SL					1440		1821		1355
LnCapacity					384		1032		768
Flow Ratio					0.1		0.4		0.3
v/c Ratio					0.54		0.65		0.61
Grn Ratio					0.27		0.57		0.57
I Factor					0.980		0.769		0.842
AT or PVG					3		3		3
Pltn Ratio					1.00		1.00		1.00
PF2					1.00		1.00		1.00
Q1					3.0		7.7		5.2
kB					0.4		0.7		0.6
Q2					0.5		1.2		0.9
Q Average					3.5		8.9		6.1
Q Spacing					25.0		25.0		25.0
Q Storage					0		0		0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2		1.2
BOQ					4.3		10.8		7.5
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5		1.5
BOQ					5.4		12.9		9.1
QSRatio									
90th Percentile Output:									
fB%					1.7		1.6		1.6
BOQ					6.1		14.1		10.1
QSRatio									
95th Percentile Output:									
fB%					2.1		1.8		1.9
BOQ					7.3		15.7		11.6
QSRatio									
98th Percentile Output:									
fB%					2.4		2.0		2.1
BOQ					8.5		17.3		13.1
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	69	25	65	21	124	24	55	649	108	55	355	28
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	563	1635	0.31	0.34	22.9	C	22.9	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	584	1695	0.31	0.34	23.0	C	23.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	414	760	0.14	0.54	10.6	B		
TR	1049	1926	0.78	0.54	20.2	C	19.5	B

Southbound

LTR	1037	1905	0.50	0.54	14.5	B	14.5	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	69	25	65	21	124	24	55	649	108	55	355	28
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	19	7	18	6	33	6	15	176	29	16	106	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		177			180		60	822			514	
%InSharedLn												
Prop LTs		0.435			0.122		1.000	0.000			0.126	
Prop RTs		0.407			0.144			0.142			0.051	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	69	25	65	21	124	24	55	649	108	55	355	28
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	77	28	72	22	132	26	60	705	117	65	423	26
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	177			180			60 822			514		
Prop LTs	0.435			0.122			1.000 0.000			0.126		
Prop RTs	0.407			0.144			0.142			0.051		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.945			0.980			0.979			0.992		
fLT	0.812			0.955			0.442 1.000			0.649		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1635			1695			760 1926			1905		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	177	1635	# 0.11	0.34	563	0.31
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	180	1695	0.11	0.34	584	0.31
Right							
Northbound							
Prot							
Perm							
Left	L	60	760	0.08	0.54	414	0.14
Prot							
Perm							
Thru	TR	822	1926	# 0.43	0.54	1049	0.78
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	514	1905	0.27	0.54	1037	0.50
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.31	0.34	21.7	1.000	563	0.50	1.2	0.0	22.9	C	22.9	C	
Westbound													
LTR	0.31	0.34	21.6	1.000	584	0.50	1.4	0.0	23.0	C	23.0	C	
Northbound													
L	0.14	0.54	10.1	1.000	414	0.50	0.5	0.0	10.6	B			
TR	0.78	0.54	16.3	1.000	1049	0.50	3.9	0.0	20.2	C	19.5	B	
Southbound													
LTR	0.50	0.54	12.8	1.000	1037	0.50	1.7	0.0	14.5	B	14.5	B	

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			60	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.13	
Adjusted opposing flow rate, Vo (veh/h)			514	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.50	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.75	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			2.23	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			46.77	
n=Max(gq-gf)/2,0)			1.12	
PTHo=1-PLTo			0.87	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.16	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.11	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			2.23	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.44	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.442	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	77	22	65
Proportion of LT in LT lane group, PLT	0.435	0.122	0.000
Proportion of LT in opposing flow, PLTo	0.12	0.44	0.00
Adjusted opposing flow rate, Vo (veh/h)	180	177	822
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.93	0.55	1.63
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.50	4.43	20.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.5	12.2	9.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	4.93	4.81	29.46
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.07	18.82	19.54
n=Max(gq-gf)/2,0)	0.74	0.00	10.21
PTHo=1-PLTo	0.88	0.56	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.44	0.12	0.44
EL1 (refer to Exhibit C16-3)	1.66	1.66	3.15
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	1.47	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.95	0.39
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.812	0.955	0.649

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	4.93	4.81	2.23	29.46
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.159	0.155	0.046	0.601
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	180	177	514	822
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.435	0.122	1.000	0.126
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.407	0.144	0.142	0.051
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.7	0.00	0.0	0.0	22.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	21.6	0.00	0.0	0.0	23.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.1	0.00	0.0	0.0	10.6
TR	0.0	0.00	20.5	16.3	0.00	0.0	0.0	20.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	12.8	0.00	0.0	0.0	14.5
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	177		180		60	822	269	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	
SL	1635		1695		760	1926	1000	
LnCapacity	563		584		414	1049	544	
Flow Ratio	0.1		0.1		0.1	0.4	0.3	
v/c Ratio	0.31		0.31		0.14	0.78	0.49	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	3.3		3.3		0.7	16.3	4.2	
kB	0.6		0.8		0.4	0.8	0.7	
Q2	0.3		0.3		0.1	2.5	0.7	
Q Average	3.5		3.6		0.8	18.9	4.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	4.4		4.6		1.0	22.7	6.1	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.7	1.4	1.5	
BOQ	5.5		5.6		1.3	26.6	7.4	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.7	
BOQ	6.2		6.4		1.6	28.5	8.3	
QSRatio								
95th Percentile Output:								
fB%	2.1		2.1		2.5	1.6	2.0	
BOQ	7.4		7.6		2.0	30.6	9.7	
QSRatio								
98th Percentile Output:								
fB%	2.4		2.4		3.0	1.7	2.3	
BOQ	8.6		8.8		2.4	32.7	11.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	275						742			380		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0					50.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.46	0.33	25.8	C	25.8	C

Westbound

Northbound

T 2156 3880 0.38 0.56 11.6 B 11.6 B

Southbound

T 1951 3512 0.23 0.56 10.5 B 10.5 B

Intersection Delay = 14.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	275						742			380		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	76						204			113		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	306						815			452		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	275						742			380		
PHF	0.90						0.91			0.84		
Adj flow	306						815			452		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	306						815			452		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.990				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3880				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	306	2006	# 0.15	0.33	669	0.46
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	815	3880	# 0.21	0.56	2156	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	452	3512	0.13	0.56	1951	0.23
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.36$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.41$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.46	0.33	23.6	1.000	669	0.50	2.2	0.0	25.8	C	25.8	C	
Westbound													
Northbound													
T	0.38	0.56	11.3	1.000	2156	0.50	0.3	0.0	11.6	B	11.6	B	
Southbound													
T	0.23	0.56	10.2	1.000	1951	0.50	0.3	0.0	10.5	B	10.5	B	

Intersection delay = 14.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	306						428		237	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.2						0.2		0.1	
v/c Ratio	0.46						0.38		0.23	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.0						6.0		3.0	
kB	0.9						0.8		1.1	
Q2	0.7						0.5		0.3	
Q Average	6.7						6.5		3.4	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.3	
BOQ	8.3						8.0		4.2	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.6	
BOQ	10.0						9.7		5.2	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.8	
BOQ	11.0						10.7		5.9	
QSRatio										
95th Percentile Output:										
fB%	1.9						1.9		2.1	
BOQ	12.5						12.2		7.1	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.5	
BOQ	14.1						13.7		8.3	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					380	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					113	
Hourly Flow Rate, HFR					452	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						57
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						20
Hourly Flow Rate, HFR						81
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								226
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		226
Potential Capacity		688
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		688
Probability of Queue free St.	1.00	0.88
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	574
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	574
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	574	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	574	900
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.		
	7	10
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	645
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	645
Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	816	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity	720	1029
Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		
Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						81
Movement Capacity (vph)						688
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						688
Volume						81
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								81
C(m) (vph)								688
v/c								0.12
95% queue length								0.40
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	72	156	159	196	470	51	85	142	71	5	26	40
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	576	0.43	0.33	28.7	C		
TR	580	1740	0.54	0.33	27.3	C	27.5	C
Westbound								
L	231	694	0.97	0.33	81.9	F		
TR	1101	3304	0.54	0.33	26.2	C	41.5	D
Northbound								
LTR	899	3238	0.36	0.28	27.2	C	27.2	C
Southbound								
L	376	1694	0.02	0.22	27.4	C		
TR	348	1565	0.28	0.22	31.1	C	30.8	C

Intersection Delay = 34.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	72	156	159	196	470	51	85	142	71	5	26	40
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	20	44	45	56	135	15	23	38	19	2	10	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	82	315		225	594			320		7	99	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.284			0.000	
Prop RTs		0.438			0.091			0.237			0.606	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	72	156	159	196	470	51	85	142	71	5	26	40
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	82	177	138	225	540	54	91	153	76	7	39	60
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	82	315		225	594		320			7	99	
Prop LTs	1.000	0.000		1.000	0.000		0.284			0.000		
Prop RTs	0.438			0.091			0.237			0.606		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.980	0.980		0.926	0.926		0.926			0.971	0.971	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.934			0.986		0.964				0.909	
fLT	0.320	1.000		0.423	1.000		0.986			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	576	1740		694	3304		3238			1694	1565	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	82	576	0.14	0.33	192	0.43
Prot							
Perm							
Thru	TR	315	1740	0.18	0.33	580	0.54
Right							
Westbound							
Prot							
Perm							
Left	L	225	694	# 0.32	0.33	231	0.97
Prot							
Perm							
Thru	TR	594	3304	0.18	0.33	1101	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	320	3238	# 0.10	0.28	899	0.36
Right							
Southbound							
Prot							
Perm							
Left	L	7	1694	0.00	0.22	376	0.02
Prot							
Perm							
Thru	TR	99	1565	# 0.06	0.22	348	0.28
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.43	0.33	23.3	1.000	192	0.50	5.3	0.0	28.7	C		
TR	0.54	0.33	24.4	1.000	580	0.50	2.8	0.0	27.3	C	27.5	C
Westbound												
L	0.97	0.33	29.6	1.000	231	0.50	52.3	0.0	81.9	F		
TR	0.54	0.33	24.4	1.000	1101	0.50	1.9	0.0	26.2	C	41.5	D
Northbound												
LTR	0.36	0.28	26.0	1.000	899	0.50	1.1	0.0	27.2	C	27.2	C
Southbound												
L	0.02	0.22	27.3	1.000	376	0.50	0.1	0.0	27.4	C		
TR	0.28	0.22	29.1	1.000	348	0.50	2.0	0.0	31.1	C	30.8	C

Intersection delay = 34.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	82	225		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	594	315		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.05	5.63		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.80	7.88		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.58	7.73		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.42	22.27		
n=Max(gq-gf)/2,0)	3.79	3.86		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.34	1.76		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.42		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.320	0.423		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.284 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.58			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.253			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	594			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.091
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.3	0.00	0.0	0.0	28.7
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	27.3
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	29.6	0.00	0.0	0.0	81.9
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.0	0.00	0.0	0.0	27.2
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	27.3	0.00	0.0	0.0	27.4
TR	0.0	0.00	35.0	29.1	0.00	0.0	0.0	31.1
	0.0						0.0	
Intersection Delay			34.7	sec/veh	Intersection LOS C			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	82	315		225	311		168			7	99	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	576	1740		694	1735		1700			1694	1565	
LnCapacity	192	580		231	578		472			376	348	
Flow Ratio	0.1	0.2		0.3	0.2		0.1			0.0	0.1	
v/c Ratio	0.43	0.54		0.97	0.54		0.36			0.02	0.28	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.6	6.4		5.6	6.3		3.4			0.1	2.1	
kB	0.3	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.2	0.7		3.0	0.9		0.4			0.0	0.2	
Q Average	1.8	7.1		8.6	7.2		3.7			0.1	2.3	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	2.3	8.7		10.4	8.8		4.7			0.2	2.9	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.5	1.5		1.5			1.7	1.6	
BOQ	2.9	10.5		12.4	10.6		5.8			0.2	3.6	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.6	1.6		1.7			2.0	1.8	
BOQ	3.3	11.5		13.6	11.6		6.5			0.3	4.1	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.8		1.8	1.8		2.1			2.6	2.2	
BOQ	4.1	13.1		15.2	13.2		7.7			0.4	5.1	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.1		2.0	2.1		2.4			3.2	2.7	
BOQ	4.9	14.7		16.9	14.8		9.0			0.5	6.0	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						380			
Peak-Hour Factor, PHF						0.95			
Hourly Flow Rate, HFR						400			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		173							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		186							
Percent Heavy Vehicles		8							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage				/				/	
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			186							
C(m) (vph)			594							
v/c			0.31							
95% queue length			1.33							
Control Delay			13.8							
LOS			B							
Approach Delay				13.8						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 380
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 100
 Hourly Flow Rate, HFR 400
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 173
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 47
 Hourly Flow Rate, HFR 186
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			400					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.		9		12
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 2: LT from Major St.		4		1
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Maj L-Shared Prob Q free St.				
Step 3: TH from Minor St.		8		11
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor		1.00		1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity				
Probability of Queue free St.		1.00		1.00
Step 4: LT from Minor St.		7		10
Conflicting Flows		400		
Potential Capacity		594		
Pedestrian Impedance Factor		1.00		1.00
Maj. L, Min T Impedance factor				1.00
Maj. L, Min T Adj. Imp Factor.				1.00
Cap. Adj. factor due to Impeding mvmnt		1.00		1.00
Movement Capacity		594		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.		8		11
Part 1 - First Stage				
Conflicting Flows				
Potential Capacity				
Pedestrian Impedance Factor				
Cap. Adj. factor due to Impeding mvmnt				
Movement Capacity				
Probability of Queue free St.				

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 400
Potential Capacity 594
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 594

Results for Two-stage process:
a
y
C t 594

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	186					
Movement Capacity (vph)	594					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	594					
Volume	186					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			186					
C(m) (vph)			594					
v/c			0.31					
95% queue length			1.33					
Control Delay			13.8					
LOS			B					
Approach Delay				13.8				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Bricktown Way/Tyrellan Ave
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	51	28	32	58	67	13	16	21	21	52	16
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.80	0.80	0.78	0.78	0.86	1.00	0.92	0.92
Flow Rate	38	66	78	122	33	21	50	45
% Heavy Veh	21	21	1	1	5	0	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	38	66	78	122	33	21	50	45
Left-Turn	7	0	41	0	15	0	22	0
Right-Turn	0	34	0	85	0	21	0	17
Prop. Left-Turns	0.2	0.0	0.5	0.0	0.5	0.0	0.4	0.0
Prop. Right-Turns	0.0	0.5	0.0	0.7	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	52	32	135	172	394	6	229	91	50	10	157	99
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	768	3004	0.32	0.26	28.2	C	28.2	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	883	3455	0.75	0.26	36.2	D	36.2	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	308	955	0.85	0.32	53.3	D		
TR	576	1788	0.28	0.32	24.0	C	42.1	D

Southbound

LTR	882	2736	0.40	0.32	25.0	C	25.0	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 34.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52	32	135	172	394	6	229	91	50	10	157	99
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	38	49	113	2	66	26	14	3	52	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		248			658		263	162			350	
%InSharedLn												
Prop LTs		0.238			0.301		1.000	0.000			0.037	
Prop RTs		0.617			0.011			0.352			0.371	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52	32	135	172	394	6	229	91	50	10	157	99
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	59	36	153	198	453	7	263	105	57	13	207	130
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	248			658			263 162			350		
Prop LTs	0.238			0.301			1.000 0.000			0.037		
Prop RTs	0.617			0.011			0.352			0.371		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.907			0.998			0.947			0.944		
fLT	0.988			0.985			0.506 1.000			0.944		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3004			3455			955 1788			2736		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	248	3004	# 0.08	0.26	768	0.32
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	658	3455	# 0.19	0.26	883	0.75
Right							
Northbound							
Prot							
Perm							
Left	DefL	263	955	# 0.28	0.32	308	0.85
Prot							
Perm							
Thru	TR	162	1788	0.09	0.32	576	0.28
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	350	2736	0.13	0.32	882	0.40
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.32	0.26	27.2	1.000	768	0.50	1.0	0.0	28.2	C	28.2	C	
Westbound													
LTR	0.75	0.26	30.8	1.000	883	0.50	5.4	0.0	36.2	D	36.2	D	
Northbound													
DefL	0.85	0.32	28.5	1.000	308	0.50	24.8	0.0	53.3	D			
TR	0.28	0.32	22.7	1.000	576	0.50	1.2	0.0	24.0	C	42.1	D	
Southbound													
LTR	0.40	0.32	23.7	1.000	882	0.50	1.3	0.0	25.0	C	25.0	C	

Intersection delay = 34.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			263	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			350	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.58	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.60	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			1.94	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			27.06	
n=Max(gq-gf)/2,0)			0.97	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.84	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			1.94	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.51	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.506	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	13
Proportion of LT in LT lane group, PLT	0.238 0.301 0.000 0.037
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	162
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.33
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.03
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	14.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.44
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	1.63
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdif=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.944

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				162
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.037
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.617	0.011	0.352
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	27.2	0.00	0.0	0.0	28.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	30.8	0.00	0.0	0.0	36.2
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	28.5	0.00	0.0	0.0	53.3
TR	0.0	0.00	30.5	22.7	0.00	0.0	0.0	24.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	23.7	0.00	0.0	0.0	25.0
	0.0						0.0	
Intersection Delay			34.2	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	130		345		263	162	183	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1577		1814		955	1788	1436	
LnCapacity	403		463		308	576	463	
Flow Ratio	0.1		0.2		0.3	0.1	0.1	
v/c Ratio	0.32		0.75		0.85	0.28	0.40	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.916		0.953			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	2.6		7.9		6.1	3.0	3.6	
kB	0.6		0.6		0.5	0.8	0.7	
Q2	0.3		1.7		2.1	0.3	0.4	
Q Average	2.9		9.6		8.3	3.3	4.0	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2		1.2	1.3	1.2	
BOQ	3.6		11.7		10.1	4.2	5.0	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.4		1.5	1.6	1.5	
BOQ	4.5		13.9		12.1	5.2	6.1	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.6		1.6	1.8	1.7	
BOQ	5.2		15.1		13.2	5.8	6.9	
QSRatio								
95th Percentile Output:								
fB%	2.2		1.7		1.8	2.1	2.1	
BOQ	6.3		16.8		14.8	7.0	8.2	
QSRatio								
98th Percentile Output:								
fB%	2.5		1.9		2.0	2.5	2.4	
BOQ	7.4		18.4		16.4	8.2	9.5	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	767	231	19	4	265	245	4	16	6	106	5	140
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	856	1728	0.98	0.71	37.9	D		
TR	1157	1627	0.24	0.71	4.8	A	29.8	C
Westbound								
LT	449	1835	0.70	0.24	39.1	D	40.9	D
R	383	1568	0.74	0.24	43.0	D		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.54	0.18	42.6	D		
LT	320	1801	0.02	0.18	30.6	C	22.4	C
R	952	1478	0.17	0.64	6.8	A		

Intersection Delay = 32.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	767	231	19	4	265	245	4	16	6	106	5	140
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	211	63	5	1	77	71	3	11	4	30	2	40
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	843	275			313	285		70		122	6	161
%InSharedLn										0		
Prop LTs	1.000	0.000			0.016			0.157		1.000	0.000	
Prop RTs		0.076			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	767	231	19	4	265	245	4	16	6	106	5	140
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	843	254	21	5	308	285	11	43	16	122	6	161
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	843	275			313	285		70		122	6	161
Prop LTs	1.000	0.000			0.016			0.157		1.000	0.000	
Prop RTs		0.076			0.000	1.000		0.229			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.989		1.000	0.850		0.969				1.000	0.850
fLT	0.950	1.000		0.995			0.965			0.732	1.000	
Sec.	0.268											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1627		1835	1568		1995			1273	1801	1478
Sec.	487											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		133	487	# 0.27	0.300	146	0.91
Left	L	843			0.71	856	0.98
Prot							
Perm							
Thru	TR	275	1627	0.17	0.71	1157	0.24
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	313	1835	0.17	0.24	449	0.70
Right	R	285	1568	0.18	0.24	383	0.74
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	122	1273	# 0.10	0.18	226	0.54
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	161	1478	0.11	0.64	952	0.17

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.98	0.71	17.4	1.000	856	0.50	20.5	0.0	37.9	D			
TR	0.24	0.71	4.5	1.000	1157	0.50	0.3	0.0	4.8	A	29.8	C	
Westbound													
LT	0.70	0.24	31.0	1.000	449	0.50	8.1	0.0	39.1	D	40.9	D	
R	0.74	0.24	31.4	1.000	383	0.50	11.6	0.0	43.0	D			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.54	0.18	33.7	1.000	226	0.50	9.0	0.0	42.6	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	22.4	C	

R 0.17 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 32.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	843			122
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.02			0.16
Adjusted opposing flow rate, Vo (veh/h)	313			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.08			3.05
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.82			1.75
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	14.31			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.69			14.85
n=Max(gq-gf)/2,0)	7.16			0.58
PTHo=1-PLTo	0.98			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.75			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	6.81			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	14.31			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.27			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.268			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.016	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	275	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.88	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.83	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		275		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.016		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.076
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	843			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	14.31			
Unopposed green interval, gu	12.69			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.29			
XPerm	1.73			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	8.76			
Queue at beginning of unsaturated green, Qu	3.35			
Residual queue, Qr	2.67			
Uniform Delay, d1	17.4			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		17.4	0.00	0.0	0.0	37.9
TR	0.0	0.00	13.0	4.5	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.0	0.00	0.0	0.0	39.1
R	0.0	0.00	34.0	31.4	0.00	0.0	0.0	43.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.6
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8
Intersection Delay			32.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	843	275		313	285	70		122	6	161
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1204	1627		1835	1568	1995		1273	1801	1478
LnCapacity	856	1157		449	383	355		226	320	952
Flow Ratio	0.7	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	0.98	0.24		0.70	0.74	0.20		0.54	0.02	0.17
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	10.2	2.4		7.1	6.6	1.5		2.8	0.1	1.6
kB	0.6	0.8		0.6	0.5	0.6		0.4	0.5	1.1
Q2	7.3	0.2		1.3	1.4	0.1		0.5	0.0	0.2
Q Average	17.5	2.6		8.4	8.0	1.6		3.2	0.1	1.8
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	21.1	3.3		10.3	9.8	2.1		4.0	0.2	2.3
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5	1.5	1.6		1.6	1.7	1.6
BOQ	24.7	4.1		12.3	11.7	2.6		5.0	0.2	2.9
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.6	1.9		1.8	2.0	1.8
BOQ	26.6	4.7		13.4	12.8	3.0		5.7	0.3	3.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.2		1.8	1.8	2.3		2.1	2.6	2.3
BOQ	28.6	5.8		15.0	14.4	3.8		6.9	0.3	4.2
QSRatio										
98th Percentile Output:										
fB%	1.7	2.6		2.0	2.0	2.8		2.5	3.2	2.7
BOQ	30.6	6.8		16.7	16.0	4.5		8.0	0.4	5.0
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2015 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	318	25	0	14	66	36	6	21	10	15	36	413
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	702	1404	0.50	0.50	17.4	B		
TR	1066	2132	0.03	0.50	11.4	B	17.0	B

LTR	1545	3090	0.10	0.50	11.9	B	11.9	B
-----	------	------	------	------	------	---	------	---

LTR	1235	3176	0.07	0.39	17.4	B	17.4	B
-----	------	------	------	------	------	---	------	---

LT	671	1726	0.10	0.39	17.8	B	23.6	C
R	616	1583	0.55	0.39	24.8	C		

Intersection Delay = 18.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	318	25	0	14	66	36	6	21	10	15	36	413
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
PK 15 Vol	87	7	0	5	23	12	3	12	6	5	12	136
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9		0				155
Adj Flow	349	27			148			82			67	339
%InSharedLn												
Prop LTs	1.000	0.000			0.128			0.159			0.299	
Prop RTs		0.000			0.250			0.268			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.970			1.000			1.000			0.974	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	318	25	0	14	66	36	6	21	10	15	36	413
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	349	27	0	19	92	37	13	47	22	20	47	339
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	349	27			148			82			67	339
Prop LTs	1.000	0.000			0.128			0.159			0.299	
Prop RTs		0.000			0.250			0.268			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.962			0.960		1.000	0.850
fLT	0.658	1.000			0.930			0.924		0.927	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1404	2132			3090			3176		1726	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	349	1404	# 0.25	0.50	702	0.50
Prot							
Perm							
Thru	TR	27	2132	0.01	0.50	1066	0.03
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	148	3090	0.05	0.50	1545	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	82	3176	0.03	0.39	1235	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	67	1726	0.04	0.39	671	0.10
Right	R	339	1583	# 0.21	0.39	616	0.55

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.46$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.52$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.50	0.50	15.0	1.000	702	0.50	2.4	0.0	17.4	B		
TR	0.03	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.4	B	17.0	B
Westbound												
LTR	0.10	0.50	11.8	1.000	1545	0.50	0.1	0.0	11.9	B	11.9	B
Northbound												
LTR	0.07	0.39	17.3	1.000	1235	0.50	0.1	0.0	17.4	B	17.4	B
Southbound												
LT	0.10	0.39	17.5	1.000	671	0.50	0.3	0.0	17.8	B	23.6	C

R 0.55 0.39 21.4 1.000 616 0.50 3.4 0.0 24.8 C

Intersection delay = 18.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	349			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.13			
Adjusted opposing flow rate, Vo (veh/h)	148			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	8.73			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.94			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.87			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.52			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.658			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No		2	1	2
Adjusted LT flow rate, VLT (veh/h)		19	13	20
Proportion of LT in LT lane group, PLT	0.000	0.128	0.159	0.299
Proportion of LT in opposing flow, PLTo		0.00	0.30	0.16
Adjusted opposing flow rate, Vo (veh/h)		27	67	82
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		0.48	0.33	0.50
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.34	1.67	1.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.8	18.6	15.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		23.17	16.40	19.53
n=Max(gq-gf)/2,0)		0.00	0.00	0.00
PTHo=1-PLTo		1.00	0.70	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.26	0.32	0.30
EL1 (refer to Exhibit C16-3)		1.42	1.48	1.51
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	0.08	0.07
gdifff=max(gq-gf,0)		0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	0.94	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.930	0.924	0.927

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	148	27	67	82
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.128	0.159	0.299
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.250	0.268	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.0	0.00	0.0	0.0	17.4
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.3	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.5	0.00	0.0	0.0	17.8
R	0.0	0.00	27.5	21.4	0.00	0.0	0.0	24.8
Intersection Delay			18.9	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	349	27			77				43				67	339	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1404	2132			1622				1668				1726	1583	
LnCapacity	702	1066			811				648				671	616	
Flow Ratio	0.2	0.0			0.0				0.0				0.0	0.2	
v/c Ratio	0.50	0.03			0.09				0.07				0.10	0.55	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.970			1.000				1.000				0.974		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	5.8	0.3			1.0				0.7				1.1	6.6	
kB	0.9	1.2			1.0				0.8				0.8	0.8	
Q2	0.8	0.0			0.1				0.1				0.1	0.9	
Q Average	6.6	0.4			1.1				0.7				1.2	7.5	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	8.1	0.5			1.4				0.9				1.5	9.2	
QSRatio															
85th Percentile Output:															
fB%	1.5	1.7			1.6				1.7				1.6	1.5	
BOQ	9.8	0.6			1.8				1.2				1.9	11.0	
QSRatio															
90th Percentile Output:															
fB%	1.6	2.0			1.9				1.9				1.9	1.6	
BOQ	10.8	0.7			2.1				1.4				2.2	12.1	
QSRatio															
95th Percentile Output:															
fB%	1.9	2.5			2.4				2.5				2.4	1.8	
BOQ	12.4	0.9			2.7				1.8				2.8	13.7	
QSRatio															
98th Percentile Output:															
fB%	2.1	3.1			2.9				3.0				2.9	2.0	
BOQ	13.9	1.2			3.2				2.2				3.3	15.3	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	88		4				4	88			568	295
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		19.0					31.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.21	0.32	15.9	B	15.9	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								

Intersection Delay = 10.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	88		4				4	88		568	295	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	27		1				1	27		175	91	
Hi Ln Vol												
% Grade		0						0				
Ideal Sat	1900		1900					1900				
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	110		0					115			1065	
%InSharedLn												
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.342	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995					1.000			0.752		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	88		4				4	88		568	295	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	110		0				5	110		701	364	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	110		0					115			1065	
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.342	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.949	
fLT	0.950				0.921		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3213		3851	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	110	1680	# 0.07	0.32	532	0.21
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	115	3213	0.04	0.52	1660	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1065	3851	# 0.28	0.52	1990	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.41

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.21	0.32	15.0	1.000	532	0.50	0.9	0.0	15.9	B	15.9	B
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B		
Westbound												
Northbound												
LT	0.07	0.52	7.3	1.000	1660	0.50	0.1	0.0	7.3	A	7.3	A
Southbound												
TR	0.54	0.52	9.7	1.000	1990	0.50	0.8	0.0	10.5	B	10.5	B

Intersection delay = 10.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.043 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1065
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.32
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	8.07
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	4.18
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.921

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			8.07	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.260	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1065	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.043	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.342
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.0	0.00	0.0	0.0	15.9
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.3	0.00	0.0	0.0	7.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.7	0.00	0.0	0.0	10.5
	0.0						0.0	
Intersection Delay			10.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	110	0				60		559	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1687		2022	
LnCapacity	532	461				871		1045	
Flow Ratio	0.1	0.0				0.0		0.3	
v/c Ratio	0.21	0.00				0.07		0.53	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	1.3	0.0				0.5		6.2	
kB	0.6	0.5				0.8		0.7	
Q2	0.1	0.0				0.1		0.8	
Q Average	1.5	0.0				0.6		7.0	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	1.9	0.0				0.7		8.5	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	2.4	0.0				0.9		10.3	
QSRatio									
90th Percentile Output:									
fB%	1.9	2.0				1.9		1.6	
BOQ	2.8	0.0				1.1		11.3	
QSRatio									
95th Percentile Output:									
fB%	2.3	2.6				2.5		1.8	
BOQ	3.5	0.0				1.4		12.9	
QSRatio									
98th Percentile Output:									
fB%	2.8	3.2				3.0		2.1	
BOQ	4.2	0.0				1.7		14.5	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		421	1		3			23	442	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.44	0.42	14.9	B		
LT	575	1381	0.46	0.42	15.3	B	15.1	B

Northbound

L	282	678	0.01	0.42	10.4	B	10.4	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2059	4941	0.28	0.42	11.9	B	11.9	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		421	1		3			23	442	0
% Heavy Veh	2	2		3	3		1			1	1	1
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol	1	0		133	1		1			7	136	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			267	267		4			574		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.998		1.000				0.049	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.981			0.998		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		421	1		3			23	442	0
PHF	0.25	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	4	0		533	1		4			28	546	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			267	267		4			574		
Prop LTs	0.000			1.000 0.998			1.000			0.049		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.386		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1439 1381		678		4941	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1863	0.00	0.42	776	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	267	1439	0.19	0.42	600	0.44
Prot							
Perm							
Thru	LT	267	1381	# 0.19	0.42	575	0.46
Right							
Northbound							
Prot							
Perm							
Left	L	4	678	0.01	0.42	282	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	574	4941	# 0.12	0.42	2059	0.28
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.31
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.37

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	776	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.44	0.42	12.5	1.000	600	0.50	2.3	0.0	14.9	B			
LT	0.46	0.42	12.7	1.000	575	0.50	2.6	0.0	15.3	B	15.1	B	
Northbound													
L	0.01	0.42	10.3	1.000	282	0.50	0.1	0.0	10.4	B	10.4	B	
Southbound													
LTR	0.28	0.42	11.5	1.000	2059	0.50	0.3	0.0	11.9	B	11.9	B	

Intersection delay = 13.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		267	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.05	
Adjusted opposing flow rate, Vo (veh/h)		4	574	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.45	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	3.51	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	2.27	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	22.73	
n=Max(gq-gf)/2,0)		0.00	1.13	
PTHo=1-PLTo		1.00	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.35	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.13	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	2.27	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.39	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.386	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	266		
Proportion of LT in LT lane group, PLT	0.000	0.998	0.049
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.43		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		267	267	4		210	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1863		1439	1381	678		1813	
LnCapacity	776		600	575	282		755	
Flow Ratio	0.0		0.2	0.2	0.0		0.1	
v/c Ratio	0.01		0.44	0.46	0.01		0.28	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.981		0.998	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.2	3.2	0.0		2.3	
kB	0.7		0.6	0.6	0.4		0.7	
Q2	0.0		0.5	0.5	0.0		0.3	
Q Average	0.0		3.7	3.7	0.0		2.6	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.3	
BOQ	0.1		4.6	4.6	0.1		3.3	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.6	
BOQ	0.1		5.6	5.7	0.1		4.1	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.8	
BOQ	0.1		6.4	6.4	0.1		4.6	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.1	2.6		2.2	
BOQ	0.1		7.6	7.7	0.1		5.7	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.4	3.2		2.6	
BOQ	0.1		8.9	9.0	0.1		6.7	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	24
Peak-Hour Factor, PHF	0.82
Hourly Flow Rate, HFR	29
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	173
Peak Hour Factor, PHF	0.78
Hourly Flow Rate, HFR	221
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	221
C(m) (vph)	1049
v/c	0.21
95% queue length	0.79
Control Delay	9.3
LOS	A
Approach Delay	9.3
Approach LOS	A

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		24				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		7				
Hourly Flow Rate, HFR		29				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			173			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			55			
Hourly Flow Rate, HFR			221			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					29			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	29	
Potential Capacity	1049	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1049	
Probability of Queue free St.	0.79	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.79
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.79
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			221			
Movement Capacity (vph)			1049			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1049			
Volume			221			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					221			
C(m) (vph)					1049			
v/c					0.21			
95% queue length					0.79			
Control Delay					9.3			
LOS					A			
Approach Delay				9.3				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	60	21	128	74	0	0	0	0	12	65	27
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	100		255				53 73	
% Heavy Veh	24		5				3 3	
No. Lanes	1		1				2	
Opposing-Lanes	1		1				0	
Conflicting-lanes	2		2				1	
Geometry group	2		2				1	
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	100		255				53 73	
Left-Turn	0		162				14 0	
Right-Turn	26		0				0 33	
Prop. Left-Turns	0.0		0.6				0.3 0.0	
Prop. Right-Turns	0.3		0.0				0.0 0.5	
Prop. Heavy Vehicle	0.2		0.0				0.0 0.0	
Geometry Group	2		2				1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2				0.2	

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.3	0.2	0.1 -0.2

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	100		255				53	73
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.09		0.23				0.05	0.06
hd, final value	4.74		4.53				4.85	4.52
x, final value	0.13		0.32				0.07	0.09
Move-up time, m		2.0		2.0				2.0
Service Time	2.7		2.5				2.8	2.5

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	100		255				53	73
Service Time	2.7		2.5				2.8	2.5
Utilization, x	0.13		0.32				0.07	0.09
Dep. headway, hd	4.74		4.53				4.85	4.52
Capacity	350		505				303	323
Delay	8.46		9.65				8.22	7.98
LOS	A		A				A	A
Approach:								
Delay		8.46		9.65				8.08
LOS		A		A				A
Intersection Delay	8.99				Intersection LOS	A		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	66	0	0	145	20	56	51	52	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	89		208		92		88	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	89		208		92	88		
Left-Turn	7		0		64	0		
Right-Turn	0		25		0	59		
Prop. Left-Turns	0.1		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	77	69	53	6	39	1	383	74	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	546	1560	0.34	0.35	16.0	B	15.5	B
R	549	1568	0.07	0.35	13.3	B		

Westbound

LTR	545	1557	0.11	0.35	13.6	B	13.6	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2253	4661	0.27	0.48	9.5	A	9.5	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 11.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	77	69	53	6	39	1	383	74	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	24	22	17	2	12	1	126	24	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		184	41		58			602				
%InSharedLn												
Prop LTs		0.527			0.138			0.837				
Prop RTs		0.000	1.000		0.017			0.002				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	77	69	53	6	39	1	383	74	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	97	87	41	8	49	1	504	97	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		184	41		58			602				
Prop LTs		0.527			0.138			0.837				
Prop RTs		0.000	1.000		0.017			0.002				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.971	0.971	0.990		0.971			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.998		1.000			
fLT	0.818		0.964		0.960			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1560	1568	1557		4661			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 11.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	97	8	
Proportion of LT in LT lane group, PLT	0.527	0.138	0.837
Proportion of LT in opposing flow, PLTo	0.14	0.53	
Adjusted opposing flow rate, Vo (veh/h)	58	184	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.62	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97	3.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.6	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	2.35	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.44	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.86	0.47	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.53	0.14	
EL1 (refer to Exhibit C16-3)	1.46	1.67	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.818	0.964	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	2.35		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.112		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	58	184	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.527	0.138	0.837	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.017	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.4	0.00	0.0	0.0	16.0
R	0.0	0.00	19.5	13.0	0.00	0.0	0.0	13.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			11.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LT	R			LTR			LTR			
Init Queue		0.0	0.0			0.0			0.0			
Flow Rate		184	41			58			220			
So		1900	1900			1900			1900			
No.Lanes	0	1	1	0		1	0	0	3	0	0	0
SL		1560	1568			1557			1711			
LnCapacity		546	549			545			827			
Flow Ratio		0.1	0.0			0.0			0.1			
v/c Ratio		0.34	0.07			0.11			0.27			
Grn Ratio		0.35	0.35			0.35			0.48			
I Factor		0.999				0.998			0.978			
AT or PVG		3	3			3			3			
Pltn Ratio		1.00	1.00			1.00			1.00			
PF2		1.00	1.00			1.00			1.00			
Q1		2.3	0.5			0.7			2.2			
kB		0.6	0.6			0.6			0.7			
Q2		0.3	0.0			0.1			0.3			
Q Average		2.5	0.5			0.7			2.4			
Q Spacing		25.0	25.0			25.0			25.0			
Q Storage		0	0			0			0			
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3			1.3			1.3			
BOQ		3.2	0.6			0.9			3.1			
QSRatio												
85th Percentile Output:												
fB%		1.6	1.7			1.7			1.6			
BOQ		4.0	0.8			1.2			3.9			
QSRatio												
90th Percentile Output:												
fB%		1.8	2.0			1.9			1.8			
BOQ		4.6	1.0			1.4			4.4			
QSRatio												
95th Percentile Output:												
fB%		2.2	2.5			2.5			2.2			
BOQ		5.6	1.3			1.8			5.4			
QSRatio												
98th Percentile Output:												
fB%		2.6	3.1			3.0			2.6			
BOQ		6.6	1.5			2.2			6.4			
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	52		18				16	333		461	30	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	463	1737	0.20	0.27	18.0	B	18.0	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1011	1785	0.39	0.57	8.3	A	8.3	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1102	1944	0.52	0.57	9.4	A	9.4	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 9.7 (sec/veh) Intersection LOS = A

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52		18				16	333		461	30	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	18		6				4	94		134	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		94						392			571	
%InSharedLn												
Prop LTs		0.745						0.046			0.000	
Prop RTs		0.255						0.000			0.061	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52		18				16	333		461	30	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	70		24				18	374		536	35	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		94						392			571	
Prop LTs		0.745						0.046			0.000	
Prop RTs		0.255						0.000			0.061	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.966						1.000			0.992		
fLT	0.964						0.970			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1737						1785			1944		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	94	1737	# 0.05	0.27	463	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	392	1785	0.22	0.57	1011	0.39
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	571	1944	# 0.29	0.57	1102	0.52
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.20	0.27	17.1	1.000	463	0.50	1.0	0.0	18.0	B	18.0	B
Westbound												
Northbound												
LT	0.39	0.57	7.2	1.000	1011	0.50	1.1	0.0	8.3	A	8.3	A
Southbound												
TR	0.52	0.57	8.0	1.000	1102	0.50	1.4	0.0	9.4	A	9.4	A

Intersection delay = 9.7 (sec/veh) Intersection LOS = A

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.745	0.046	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		571	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.52	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.33	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.47	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.970	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.33	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.186	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			571	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.046	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.061
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	17.1	0.00	0.0	0.0	18.0
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.2	0.00	0.0	0.0	8.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.0	0.00	0.0	0.0	9.4
	0.0						0.0	
Intersection Delay			9.7	sec/veh	Intersection LOS		A	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	94						392			571		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1737						1785			1944		
LnCapacity	463						1011			1102		
Flow Ratio	0.1						0.2			0.3		
v/c Ratio	0.20						0.39			0.52		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.2						3.6			5.8		
kB	0.5						0.8			0.7		
Q2	0.1						0.5			0.8		
Q Average	1.3						4.1			6.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	1.7						5.1			8.1		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	2.2						6.3			9.8		
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.6		
BOQ	2.5						7.1			10.8		
QSRatio												
95th Percentile Output:												
fB%	2.4						2.0			1.9		
BOQ	3.2						8.4			12.4		
QSRatio												
98th Percentile Output:												
fB%	2.8						2.4			2.1		
BOQ	3.8						9.7			13.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	68		51				29	408		315	136	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								17	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds	X				Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds	X				Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	505	1514	0.30	0.33	16.2	B	16.2	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	806	1612	0.61	0.50	13.7	B	13.7	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	927	1853	0.54	0.50	12.4	B	12.4	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 13.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	68		51				29	408		315	136	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	21		16				8	115		92	40	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		149						491			504	
%InSharedLn												
Prop LTs		0.570						0.067			0.000	
Prop RTs	0.430						0.000			0.274		
Peds Bikes	0	0		0						0	0	
Buses	0						7			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	68		51				29	408		315	136	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	85		64				33	458		366	138	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		149						491			504	
Prop LTs		0.570						0.067			0.000	
Prop RTs		0.430						0.000			0.274	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.942						1.000			0.963		
fLT	0.972						0.950			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1514						1612			1853		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	149	1514	# 0.10	0.33	505	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	491	1612	# 0.30	0.50	806	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	504	1853	0.27	0.50	927	0.54
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.40

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.30	0.33	14.8	1.000	505	0.50	1.5	0.0	16.2	B	16.2	B
Westbound												
Northbound												
LT	0.61	0.50	10.8	1.000	806	0.50	3.0	0.0	13.7	B	13.7	B
Southbound												
TR	0.54	0.50	10.3	1.000	927	0.50	2.1	0.0	12.4	B	12.4	B

Intersection delay = 13.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		33	
Proportion of LT in LT lane group, PLT	0.570	0.067	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		504	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.55	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		11.6	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		6.99	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.38	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.07	
EL1 (refer to Exhibit C16-3)		2.31	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.950	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			6.99	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.233	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		504	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.570		0.067	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.430	0.274
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	10.8	0.00	0.0	0.0	13.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	10.3	0.00	0.0	0.0	12.4
	0.0						0.0	
Intersection Delay			13.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	149						491			504		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1514						1612			1853		
LnCapacity	505						806			927		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.30						0.61			0.54		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.8						5.9			5.8		
kB	0.5						0.6			0.8		
Q2	0.2						1.0			0.9		
Q Average	2.1						6.9			6.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.6						8.4			8.2		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.3						10.1			9.8		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.8						11.2			10.9		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	4.6						12.7			12.4		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.1		
BOQ	5.5						14.3			13.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		65	234	382	158	56	187		458	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	28.3	C
R	216	1620	0.38	0.13	28.6	C		
Westbound								
LTR	1314	4638	0.67	0.28	21.0	C	21.0	C
Northbound								
L	120	355	0.52	0.33	30.3	C		
T	575	1726	0.36	0.33	16.8	B	19.9	B
Southbound								
TR	661	1984	0.95	0.33	30.5	C	30.5	C

Intersection Delay = 24.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		65	234	382	158	56	187		458	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		21	66	109	45	16	52		151	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		82		880		62	208			631	
%InSharedLn												
Prop LTs					0.302		1.000	0.000			0.000	
Prop RTs			1.000		0.205			0.000			0.044	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		65	234	382	158	56	187		458	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		82	266	434	180	62	208		603	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		82		880		62	208			631	
Prop LTs					0.302		1.000	0.000			0.000	
Prop RTs			1.000		0.205			0.000			0.044	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.971	0.971	0.971		0.935	0.935	0.935	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.972	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.969			1.000	0.994	
fLT	0.950		0.985		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1636	1620	4638		355	1726	1984	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	82	1620	# 0.05	0.13	216	0.38
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	880	4638	# 0.19	0.28	1314	0.67
Right							
Northbound							
Prot							
Perm							
Left	L	62	355	0.17	0.33	120	0.52
Prot							
Perm							
Thru	T	208	1726	0.12	0.33	575	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	631	1984	# 0.32	0.33	661	0.95
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.56

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	28.3	C
R	0.38	0.13	23.7	1.000	216	0.50	4.9	0.0	28.6	C		
Westbound												
LTR	0.67	0.28	19.0	1.000	1314	0.50	2.0	0.0	21.0	C	21.0	C
Northbound												
L	0.52	0.33	16.1	1.000	120	0.50	14.2	0.0	30.3	C	19.9	B
T	0.36	0.33	15.2	1.000	575	0.50	1.7	0.0	16.8	B		
Southbound												
TR	0.95	0.33	19.6	1.000	661	0.50	10.9	0.0	30.5	C	30.5	C

Intersection delay = 24.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			62	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			631	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			1.03	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.52	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			14.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.69	
n=Max(gq-gf)/2,0)			7.16	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.35	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.302 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.31	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.716	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			631	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.205	0.044
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	23.7	0.00	0.0	0.0	28.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.0	0.00	0.0	0.0	21.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.1	0.00	0.0	0.0	30.3
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.6	0.00	0.0	0.0	30.5
	0.0						0.0	
Intersection Delay			24.4	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	82		323		62	208		631
So	1900	1900		1900		1900	1900		1900
No.Lanes	1 0	1 0		3 0		1 1 0	0		1 0
SL	1636	1620		1702		355	1726		1984
LnCapacity	218	216		482		120	575		661
Flow Ratio	0.0	0.1		0.2		0.2	0.1		0.3
v/c Ratio	0.02	0.38		0.67		0.52	0.36		0.95
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.2		4.8		0.8	2.6		10.3
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	0.2		0.7		0.2	0.3		2.4
Q Average	0.1	1.4		5.5		1.0	2.9		12.7
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	1.8		6.8		1.3	3.7		15.3
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.4
BOQ	0.1	2.3		8.2		1.7	4.6		18.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.9		1.7		1.9	1.8		1.5
BOQ	0.1	2.7		9.2		2.0	5.2		19.5
QSRatio									
95th Percentile Output:									
fB%	2.6	2.4		1.9		2.4	2.2		1.7
BOQ	0.2	3.3		10.6		2.5	6.3		21.3
QSRatio									
98th Percentile Output:									
fB%	3.2	2.8		2.2		2.9	2.5		1.8
BOQ	0.2	4.0		12.1		3.0	7.4		23.1
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	11	37	10				5	231	84	251	475	31
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 457 1614 0.15 0.28 16.8 B 16.8 B

Westbound

Northbound

LTR 901 1638 0.40 0.55 9.0 A 9.0 A

Southbound

L 542 986 0.58 0.55 11.3 B
 TR 960 1745 0.66 0.55 11.4 B 11.3 B

Intersection Delay = 11.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	11	37	10				5	231	84	251	475	31
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	3	11	3				2	64	23	78	148	10
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig			LTR						LTR	L		TR
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		69						356		314	633	
%InSharedLn												
Prop LTs			0.188						0.017	1.000	0.000	
Prop RTs		0.174						0.261			0.062	
Peds Bikes	0		0	0			0		0	0		0
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	11	37	10				5	231	84	251	475	31
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	13	44	12				6	257	93	314	594	39
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L TR		
Adj flow	69						356			314 633		
Prop LTs	0.188						0.017			1.000 0.000		
Prop RTs	0.174						0.261			0.062		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L TR		
So	1900						1900			1900 1900		
Lanes 0	1	0	0	0	0	0	1	0		1	1	0
fW	1.033						1.133			1.000 1.000		
fHV	0.971						0.935			0.935 0.935		
fG	1.000						1.000			1.000 1.000		
fP	0.875						0.875			1.000 1.000		
fBB	1.000						0.972			1.000 0.992		
fA	1.000						1.000			1.000 1.000		
fLU	1.000						1.000			1.000 1.000		
fRT	0.977						0.965			0.991		
fLT	0.991						0.992			0.555 1.000		
Sec.												
fLpb	1.000						1.000			1.000 1.000		
fRpb	1.000						1.000			1.000		
S	1614						1638			986 1745		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	69	1614	# 0.04	0.28	457	0.15
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	356	1638	0.22	0.55	901	0.40
Right							
Southbound							
Prot							
Perm							
Left	L	314	986	0.32	0.55	542	0.58
Prot							
Perm							
Thru	TR	633	1745	# 0.36	0.55	960	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.49

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.15	0.28	16.1	1.000	457	0.50	0.7	0.0	16.8	B	16.8	B
Westbound												
Northbound												
LTR	0.40	0.55	7.8	1.000	901	0.50	1.2	0.0	9.0	A	9.0	A
Southbound												
L	0.58	0.55	8.9	1.000	542	0.50	2.3	0.0	11.3	B		
TR	0.66	0.55	9.5	1.000	960	0.50	1.9	0.0	11.4	B	11.3	B

Intersection delay = 11.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				314
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				356
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.23
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				5.93
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.77
n=Max(gq-gf)/2,0)				1.61
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.82
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.61
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				3.23
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.56
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.555

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		6	
Proportion of LT in LT lane group, PLT	0.188	0.017	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		633	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.10	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.55	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		7.76	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.14	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.62	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.76	3.23
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.235	0.098
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			633	356
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.017	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.174	0.261	0.062
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.8
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	7.8	0.00	0.0	0.0	9.0
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.9	0.00	0.0	0.0	11.3
TR	0.0	0.00	13.5	9.5	0.00	0.0	0.0	11.4
	0.0						0.0	

Intersection Delay	11.0	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		69						356			314	633
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1614						1638			986	1745
LnCapacity		457						901			542	960
Flow Ratio		0.0						0.2			0.3	0.4
v/c Ratio		0.15						0.40			0.58	0.66
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.941				0.518
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.9						3.4			3.5	7.4
kB		0.5						0.8			0.3	0.4
Q2		0.1						0.5			0.4	0.8
Q Average		0.9						3.9			3.9	8.3
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.2						4.9			4.8	10.1
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.5
BOQ		1.6						6.0			5.9	12.1
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.7	1.6
BOQ		1.8						6.7			6.7	13.2
QSRatio												
95th Percentile Output:												
fB%		2.4						2.1			2.1	1.8
BOQ		2.3						8.0			7.9	14.8
QSRatio												
98th Percentile Output:												
fB%		2.9						2.4			2.4	2.0
BOQ		2.8						9.3			9.2	16.4
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	20	12	166	16	101	9	176	127	134	297	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 652 1466 0.09 0.44 14.7 B 14.7 B

Westbound

L 549 1235 0.34 0.44 18.1 B
 T 777 1749 0.02 0.44 14.1 B 17.1 B
 R 574 1291 0.20 0.44 16.0 B

Northbound

LTR 692 1558 0.50 0.44 20.1 C 20.1 C

Southbound

LTR 557 1253 1.04 0.44 47.9 D 47.9 D

Intersection Delay = 31.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	20	12	166	16	101	9	176	127	134	297	8
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	4	47	5	29	3	49	35	44	98	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		189	18	115		347			578	
%InSharedLn												
Prop LTs		0.175		1.000	0.000			0.029			0.304	
Prop RTs		0.316			0.000	1.000		0.406			0.019	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.966			0.850			0.090	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	20	12	166	16	101	9	176	127	134	297	8
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	10	29	18	189	18	115	10	196	141	176	391	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	57			189	18	115	347			578		
Prop LTs	0.175			1.000	0.000		0.029			0.304		
Prop RTs	0.316			0.000 1.000			0.406			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.971			0.952	0.952	0.952	0.935			0.935		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	0.992			1.000	1.000	0.992	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.957				1.000	0.850	0.945			0.997		
fLT	0.973			0.720	1.000		0.982			0.714		
Sec.												
fLpb	1.000			0.948	1.000		1.000			0.991		
fRpb	0.982				1.000	1.000	0.977			1.000		
S	1466			1235	1749	1291	1558			1253		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1466	0.04	0.44	652	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	189	1235	# 0.15	0.44	549	0.34
Prot							
Perm							
Thru	T	18	1749	0.01	0.44	777	0.02
Right	R	115	1291	0.09	0.44	574	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	347	1558	0.22	0.44	692	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	578	1253	# 0.46	0.44	557	1.04
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.69

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	652	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.34	0.44	16.4	1.000	549	0.50	1.7	0.0	18.1	B	17.1	B
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B		
R	0.20	0.44	15.2	1.000	574	0.50	0.8	0.0	16.0	B		
Northbound												
LTR	0.50	0.44	17.9	1.000	692	0.50	2.2	0.0	20.1	C	20.1	C
Southbound												
LTR	1.04	0.44	25.0	1.000	557	0.50	22.9	0.0	47.9	D	47.9	D

Intersection delay = 31.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		189		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.18		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.72		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.82		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	10	10	176	
Proportion of LT in LT lane group, PLT	0.175	0.000	0.029	0.304
Proportion of LT in opposing flow, PLTo	0.00	0.30	0.03	
Adjusted opposing flow rate, Vo (veh/h)	18	578	347	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.25	0.25	4.40	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45	14.45	8.68	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	22.9	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.28	8.74	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	17.08	31.26	
n=Max(gq-gf)/2,0)	0.00	0.00	4.37	
PTHo=1-PLTo	1.00	0.70	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.18	0.03	0.30	
EL1 (refer to Exhibit C16-3)	1.40	2.48	1.97	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.16	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.07	
gdifff=max(gq-gf,0)	0.00	0.00	8.74	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.98	0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.973	0.982	0.714	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.28	8.74
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.382	0.219
OCCpedu	0.000	0.056	0.000	0.050
Opposing flow rate, Vo (veh/h)	18	57	578	347
OCCr	0.000	0.052	0.000	0.031
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.969
Proportion of left turns, PLT	0.175	1.000	0.029	0.304
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.991
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.316	1.000	0.406	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.977	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	16.4	0.00	0.0	0.0	18.1
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	17.9	0.00	0.0	0.0	20.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	5.2	0.0	47.9
	0.0						0.0	
Intersection Delay			31.4	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		57	189	18	115		347		578
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1466	1235	1749	1291		1558		1253
LnCapacity		652	549	777	574		692		557
Flow Ratio		0.0	0.2	0.0	0.1		0.2		0.5
v/c Ratio		0.09	0.34	0.02	0.20		0.50		1.04
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	3.1	0.3	1.8		6.2		14.4
kB		0.8	0.7	0.9	0.7		0.8		0.1
Q2		0.1	0.4	0.0	0.2		0.7		3.9
Q Average		0.9	3.5	0.3	1.9		6.9		18.3
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.2	4.3	0.4	2.5		8.5		22.1
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.5		1.4
BOQ		1.5	5.4	0.5	3.1		10.2		25.8
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		1.7	6.1	0.5	3.6		11.3		27.7
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.8		1.6
BOQ		2.2	7.3	0.7	4.4		12.8		29.8
QSRatio									
98th Percentile Output:									
fB%		3.0	2.4	3.1	2.7		2.1		1.7
BOQ		2.7	8.5	0.9	5.3		14.4		31.9
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	135	182		84	168		217		78			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	894	1788	0.33	0.50	14.5	B	14.5	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	754	1508	0.38	0.50	15.3	B	15.3	B
----	-----	------	------	------	------	---	------	---

Northbound

LR	533	1371	0.59	0.39	25.9	C	25.9	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		135	182	84	168		217		78			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		37	49	24	47		58		21			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		297			283			314				
%InSharedLn												
Prop LTs		0.000			0.332			0.736				
Prop RTs		0.505			0.000			0.264				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		135	182	84	168		217		78			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		147	150	94	189		231		83			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		297			283			314				
Prop LTs		0.000			0.332			0.736				
Prop RTs		0.505			0.000			0.264				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.932			1.000			0.964					
fLT	1.000			0.791			0.965					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1788			1508			1371					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	297	1788	0.17	0.50	894	0.33
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	283	1508	# 0.19	0.50	754	0.38
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	314	1371	# 0.23	0.39	533	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.33	0.50	13.5	1.000	894	0.50	1.0	0.0	14.5	B	14.5	B
Westbound												
LT	0.38	0.50	13.8	1.000	754	0.50	1.4	0.0	15.3	B	15.3	B
Northbound												
LR	0.59	0.39	21.8	1.000	533	0.50	4.1	0.0	25.9	C	25.9	C
Southbound												

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	94		
Proportion of LT in LT lane group, PLT	0.000	0.332	0.736
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	297		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	2.35		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.43		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	5.3		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	5.92		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	39.08		
n=Max(gq-gf)/2,0)	0.29		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.33		
EL1 (refer to Exhibit C16-3)	1.88		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.79		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.791		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.5	0.00	0.0	0.0	14.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	13.8	0.00	0.0	0.0	15.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	21.8	0.00	0.0	0.0	25.9
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		297			283			314				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1788			1508			1371				
LnCapacity		894			754			533				
Flow Ratio		0.2			0.2			0.2				
v/c Ratio		0.33			0.38			0.59				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.964			0.986			0.858				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		4.5			4.4			6.2				
kB		1.0			0.9			0.6				
Q2		0.5			0.6			0.9				
Q Average		5.0			4.9			7.1				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		6.1			6.1			8.7				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		7.5			7.4			10.5				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.7			1.6				
BOQ		8.4			8.3			11.5				
QSRatio												
95th Percentile Output:												
fB%		2.0			2.0			1.8				
BOQ		9.8			9.7			13.1				
QSRatio												
98th Percentile Output:												
fB%		2.3			2.3			2.1				
BOQ		11.2			11.1			14.6				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrotts Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	23	17	37	34	19	24	35	230	35	31	244	22
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 229 1965 0.43 0.12 30.4 C 30.4 C

Westbound

LTR 459 1836 0.19 0.25 18.7 B 18.7 B

Northbound

LTR 692 1805 0.51 0.38 16.9 B 16.9 B

Southbound

LTR 642 1674 0.51 0.38 17.0 B 17.0 B

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	23	17	37	34	19	24	35	230	35	31	244	22
% Heavy Veh	1	1	1	10	10	10	8	8	8	18	18	18
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
PK 15 Vol	7	5	12	10	5	7	10	68	10	9	67	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		98			88			353			326	
%InSharedLn												
Prop LTs		0.296			0.443			0.116			0.104	
Prop RTs		0.480			0.307			0.116			0.074	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			3			3	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	23	17	37	34	19	24	35	230	35	31	244	22
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
Adj flow	29	22	47	39	22	27	41	271	41	34	268	24
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	98			88			353			326		
Prop LTs	0.296			0.443			0.116			0.104		
Prop RTs	0.480			0.307			0.116			0.074		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.990			0.909			0.926			0.847		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.988			0.988		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.935			0.959			0.984			0.990		
fLT	0.985			0.978			0.931			0.938		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1965			1836			1805			1674		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	98	1965	# 0.05	0.12	229	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1836	# 0.05	0.25	459	0.19
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	353	1805	# 0.20	0.38	692	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	326	1674	0.19	0.38	642	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.29
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.43	0.12	24.6	1.000	229	0.50	5.8	0.0	30.4	C	30.4	C
Westbound												
LTR	0.19	0.25	17.7	1.000	459	0.50	0.9	0.0	18.7	B	18.7	B
Northbound												
LTR	0.51	0.38	14.2	1.000	692	0.50	2.7	0.0	16.9	B	16.9	B
Southbound												
LTR	0.51	0.38	14.2	1.000	642	0.50	2.9	0.0	17.0	B	17.0	B

Intersection delay = 18.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			41	34
Proportion of LT in LT lane group, PLT	0.296	0.443	0.116	0.104
Proportion of LT in opposing flow, PLTo			0.10	0.12
Adjusted opposing flow rate, Vo (veh/h)			326	353
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.68	0.57
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.43	5.88
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.7	7.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			5.75	6.42
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.31	15.40
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.90	0.88
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.12	0.10
EL1 (refer to Exhibit C16-3)			1.93	1.99
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.93	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.931	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.42
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.279
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				353
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.104
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.480	0.116
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	30.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.7	0.00	0.0	0.0	18.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.2	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.2	0.00	0.0	0.0	17.0
	0.0						0.0	
Intersection Delay			18.6	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	98		88		353		326	
So	1900		1900		1900		1900	
No.Lanes	1	0	1	0	1	0	1	0
SL	1965		1836		1805		1674	
LnCapacity	229		459		692		642	
Flow Ratio	0.0		0.0		0.2		0.2	
v/c Ratio	0.43		0.19		0.51		0.51	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.5		1.2		4.5		4.2	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.1		0.7		0.6	
Q Average	1.7		1.3		5.2		4.8	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.2		1.6		6.4		5.9	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.8		2.1		7.8		7.3	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.9		1.7		1.7	
BOQ	3.2		2.4		8.7		8.1	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.4		2.0		2.0	
BOQ	4.0		3.0		10.1		9.5	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.9		2.2		2.3	
BOQ	4.8		3.6		11.6		10.9	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		286	18			19	297	
Peak-Hour Factor, PHF		0.85	0.85			0.91	0.91	
Hourly Flow Rate, HFR		336	21			20	326	
Percent Heavy Vehicles		--	--			15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		43		15				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		45		15				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		20			60					
C(m) (vph)		1133			443					
v/c		0.02			0.14					
95% queue length		0.05			0.47					
Control Delay		8.2			14.4					
LOS		A			B					
Approach Delay					14.4					
Approach LOS					B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		286	18	19	297	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		84	5	5	82	
Hourly Flow Rate, HFR		336	21	20	326	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	43		15			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	11		4			
Hourly Flow Rate, HFR	45		15			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		326
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		357	712		346			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	346	
Potential Capacity	702	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	702	
Probability of Queue free St.	0.98	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	357	
Potential Capacity	1133	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1133	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	712	
Potential Capacity	402	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	395	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 712
Potential Capacity 402
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 395

Results for Two-stage process:

a
y
C t 395

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	45		15			
Movement Capacity (vph)	395		702			
Shared Lane Capacity (vph)		443				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	395		702			
Volume	45		15			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		443				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		20		60				
C(m) (vph)		1133		443				
v/c		0.02		0.14				
95% queue length		0.05		0.47				
Control Delay		8.2		14.4				
LOS		A		B				
Approach Delay				14.4				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		326
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	273	23	393	1	140	269	165	174	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	713	1711	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	522	1252	0.63	0.42	18.9	B	25.0	C
R	518	1244	0.84	0.42	29.6	C		

Northbound

LTR	706	1694	0.63	0.42	17.8	B	17.8	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	467	1121	0.85	0.42	32.8	C	32.8	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 24.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	273	23	393	1	140	269	165	174	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	76	6	109	1	38	73	48	51	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			329	437		445			395	
%InSharedLn												
Prop LTs		0.036			0.921			0.002			0.486	
Prop RTs		0.250			0.000	1.000		0.656			0.003	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	273	23	393	1	140	269	165	174	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	303	26	437	1	152	292	192	202	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			329 437			445			395		
Prop LTs	0.036			0.921			0.002			0.486		
Prop RTs	0.250			0.000 1.000			0.656			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.911			1.000		
fLT	0.992			0.722			0.999			0.566		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1711			1252 1244			1694			1121		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1711	0.02	0.42	713	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	329	1252	0.26	0.42	522	0.63
Right	R	437	1244	# 0.35	0.42	518	0.84
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	445	1694	0.26	0.42	706	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	395	1121	# 0.35	0.42	467	0.85
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.42	10.4	1.000	713	0.50	0.1	0.0	10.5	B	10.5	B	
Westbound													
LT	0.63	0.42	13.8	1.000	522	0.50	5.1	0.0	18.9	B	25.0	C	
R	0.84	0.42	15.7	1.000	518	0.50	13.9	0.0	29.6	C			
Northbound													
LTR	0.63	0.42	13.8	1.000	706	0.50	4.0	0.0	17.8	B	17.8	B	
Southbound													
LTR	0.85	0.42	15.8	1.000	467	0.50	17.0	0.0	32.8	C	32.8	C	

Intersection delay = 24.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	303	1	192
Proportion of LT in LT lane group, PLT	0.036	0.921	0.002	0.486
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.49	0.00
Adjusted opposing flow rate, Vo (veh/h)	329	28	395	445
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.05	0.02	3.20
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.48	0.47	6.58	7.42
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.20	0.00	6.73	7.84
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	17.16
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	3.92
PTHo=1-PLTo	0.08	0.96	0.51	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	0.49
EL1 (refer to Exhibit C16-3)	1.94	1.42	2.07	2.18
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	3.91
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	7.84
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.57
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.722	0.999	0.566

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.20		6.73	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.208		0.269	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	329		395	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.8	0.00	0.0	0.0	18.9
R	0.0	0.00	17.5	15.7	0.00	0.0	0.0	29.6
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	13.8	0.00	0.0	0.0	17.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.8	0.00	0.0	0.0	32.8
	0.0						0.0	
Intersection Delay			24.7	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	28			329	437	445		395	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1711			1252	1244	1694		1121	
LnCapacity	713			522	518	706		467	
Flow Ratio	0.0			0.3	0.4	0.3		0.4	
v/c Ratio	0.04			0.63	0.84	0.63		0.85	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.887		0.931		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.3			4.3	6.6	5.9		5.9	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			0.8	2.1	1.0		2.2	
Q Average	0.3			5.1	8.7	6.9		8.2	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.4			6.3	10.6	8.5		9.9	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.5	1.5	1.5		1.5	
BOQ	0.5			7.7	12.6	10.2		11.9	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.7	1.6	1.6		1.6	
BOQ	0.6			8.6	13.8	11.2		13.0	
QSRatio									
95th Percentile Output:									
fB%	2.5			2.0	1.8	1.9		1.8	
BOQ	0.8			10.1	15.4	12.8		14.6	
QSRatio									
98th Percentile Output:									
fB%	3.1			2.2	2.0	2.1		2.0	
BOQ	0.9			11.5	17.1	14.3		16.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: Philip Habib & Associates
 Date: 6/17/13
 Period: Weekday 12-1 PM MD Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				315		3	407			453		
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.56 0.33 19.4 B 19.4 B

Northbound

T 970 1940 0.46 0.50 11.0 B 11.0 B

Southbound

T 946 1892 0.56 0.50 11.7 B 11.7 B

Intersection Delay = 13.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: Philip Habib & Associates
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				315		3	407			453		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				89		1	111			132		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					361		442			527		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				315		3	407			453		
PHF				0.88		0.88	0.92			0.86		
Adj flow				358		3	442			527		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					361			442			527	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	361	1933	# 0.19	0.33	644	0.56
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	442	1940	0.23	0.50	970	0.46
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	527	1892	# 0.28	0.50	946	0.56
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.47

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.56	0.33	16.4	1.000	644	0.50	3.0	0.0	19.4	B	19.4	B
Northbound												
T	0.46	0.50	9.7	1.000	970	0.50	1.3	0.0	11.0	B	11.0	B
Southbound												
T	0.56	0.50	10.4	1.000	946	0.50	1.3	0.0	11.7	B	11.7	B

Intersection delay = 13.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/C				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		407	234			136	632	
Peak-Hour Factor, PHF		0.92	0.92			0.86	0.86	
Hourly Flow Rate, HFR		442	254			158	734	
Percent Heavy Vehicles		--	--			16	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		158						
C(m) (vph)		838						
v/c		0.19						
95% queue length		0.69						
Control Delay		10.3						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R
Volume		407	234	136	632	
Peak-Hour Factor, PHF		0.92	0.92	0.86	0.86	
Peak-15 Minute Volume		111	64	40	184	
Hourly Flow Rate, HFR		442	254	158	734	
Percent Heavy Vehicles		--	--	16	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		734
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		696						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	696	
Potential Capacity	838	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	838	
Probability of Queue free St.	0.81	1.00
Maj L-Shared Prob Q free St.	0.67	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.67	0.67
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.67 0.67
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.81 0.81
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		158						
C(m) (vph)		838						
v/c		0.19						
95% queue length		0.69						
Control Delay		10.3						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.81
v(i1), Volume for stream 2 or 5		734
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.67
d(M,LT), Delay for stream 1 or 4		10.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		3.4

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Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				97		185	443	77		175	439	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 386 1446 0.84 0.27 39.1 D 39.1 D

Northbound

TR 1057 1866 0.54 0.57 9.8 A 9.8 A

Southbound

LT 645 1139 1.11 0.57 72.2 E 72.2 E

Intersection Delay = 43.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				97		185	443	77		175	439	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				28		53	120	21		51	128	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					324			566			713	
%InSharedLn												
Prop LTs					0.343			0.000			0.285	
Prop RTs					0.657			0.148			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				97		185	443	77		175	439	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				111		213	482	84		203	510	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					324			566			713	
Prop LTs					0.343			0.000			0.285	
Prop RTs					0.657			0.148			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.911			0.980			1.000	
fLT					0.983			1.000			0.587	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1446			1866			1139	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	324	1446	# 0.22	0.27	386	0.84
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	566	1866	0.30	0.57	1057	0.54
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	713	1139	# 0.63	0.57	645	1.11
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.85
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.02

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.84	0.27	20.8	1.000	386	0.50	18.3	0.0	39.1	D	39.1	D
Northbound												
TR	0.54	0.57	8.1	1.000	1057	0.50	1.7	0.0	9.8	A	9.8	A
Southbound												
LT	1.11	0.57	13.0	1.000	645	0.50	59.2	0.0	72.2	E	72.2	E

Intersection delay = 43.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			203
Proportion of LT in LT lane group, PLT	0.343	0.000	0.285
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			566
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.38
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			6.26
gu=g-gq if gq>=gf, or = g-gf if gq<gf			27.74
n=Max(gq-gf)/2,0)			2.96
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.28
EL1 (refer to Exhibit C16-3)			2.45
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.587

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.26
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.184
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				566
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.285
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.657	0.148
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.8	0.00	0.0	0.0	39.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.1	0.00	0.0	0.0	9.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	17.0	0.0	72.2
	0.0						0.0	
Intersection Delay			43.5	sec/veh	Intersection LOS		D	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	141	63	79	36	172	53	91	577	131	103	461	67
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	433	1258	0.76	0.34	34.1	C	34.1	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	555	1611	0.51	0.34	26.8	C	26.8	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	327	601	0.31	0.54	13.0	B		
TR	1052	1932	0.74	0.54	19.1	B	18.4	B

Southbound

LTR	935	1717	0.74	0.54	20.8	C	20.8	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 22.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	141	63	79	36	172	53	91	577	131	103	461	67
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	41	18	23	10	47	14	25	159	36	29	129	19
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		329			284		100	778			694	
%InSharedLn												
Prop LTs		0.498			0.137		1.000	0.000			0.167	
Prop RTs		0.280			0.204			0.185			0.086	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	141	63	79	36	172	53	91	577	131	103	461	67
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	164	73	92	39	187	58	100	634	144	116	518	60
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	329			284			100 778			694		
Prop LTs	0.498			0.137			1.000 0.000			0.167		
Prop RTs	0.280			0.204			0.185			0.086		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.962			0.972			0.972			0.987		
fLT	0.625			0.924			0.345 1.000			0.572		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1258			1611			601 1932			1717		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	329	1258	# 0.26	0.34	433	0.76
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	284	1611	0.18	0.34	555	0.51
Right							
Northbound							
Prot							
Perm							
Left	L	100	601	0.17	0.54	327	0.31
Prot							
Perm							
Thru	TR	778	1932	0.40	0.54	1052	0.74
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	694	1717	# 0.40	0.54	935	0.74
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.76	0.34	26.2	1.000	433	0.50	8.0	0.0	34.1	C	34.1	C
Westbound												
LTR	0.51	0.34	23.5	1.000	555	0.50	3.3	0.0	26.8	C	26.8	C
Northbound												
L	0.31	0.54	11.2	1.000	327	0.50	1.8	0.0	13.0	B		
TR	0.74	0.54	15.6	1.000	1052	0.50	3.5	0.0	19.1	B	18.4	B
Southbound												
LTR	0.74	0.54	15.7	1.000	935	0.50	5.2	0.0	20.8	C	20.8	C

Intersection delay = 22.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			100	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.17	
Adjusted opposing flow rate, Vo (veh/h)			694	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.50	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.11	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			5.41	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			43.59	
n=Max(gq-gf)/2,0)			2.71	
PTHo=1-PLTo			0.83	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.58	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.34	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			5.41	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.35	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.345	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	164	39	116
Proportion of LT in LT lane group, PLT	0.498	0.137	0.000
Proportion of LT in opposing flow, PLTo	0.14	0.50	0.00
Adjusted opposing flow rate, Vo (veh/h)	284	329	778
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	4.10	0.98	2.90
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.10	8.23	19.45
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	8.3	2.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	9.06	10.73	26.21
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.94	20.27	22.79
n=Max(gq-gf)/2,0)	4.53	1.22	11.91
PTHo=1-PLTo	0.86	0.50	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.50	0.14	0.74
EL1 (refer to Exhibit C16-3)	1.85	1.94	3.02
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.55	1.14	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.07	0.07
gdifff=max(gq-gf,0)	9.06	2.43	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.63	0.92	0.23
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.625	0.924	0.572

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	9.06	10.73	5.41	26.21
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.292	0.346	0.110	0.535
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	284	329	694	778
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.498	0.137	1.000	0.167
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.280	0.204	0.185	0.086
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	26.2	0.00	0.0	0.0 0.0 0.0	34.1
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	23.5	0.00	0.0	0.0 0.0 0.0	26.8
Northbound								
L	0.0	0.00	20.5	11.2	0.00	0.0	0.0	13.0
TR	0.0 0.0	0.00	20.5	15.6	0.00	0.0	0.0 0.0	19.1
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	15.7	0.00	0.0	0.0 0.0 0.0	20.8
Intersection Delay			22.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	329		284		100	778	364	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1258		1611		601	1932	901	
LnCapacity	433		555		327	1052	491	
Flow Ratio	0.3		0.2		0.2	0.4	0.4	
v/c Ratio	0.76		0.51		0.31	0.74	0.74	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.3		5.7		1.4	14.8	7.0	
kB	0.4		0.8		0.4	0.9	0.7	
Q2	1.2		0.8		0.2	2.3	1.7	
Q Average	8.5		6.4		1.5	17.1	8.7	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	10.4		7.9		2.0	20.6	10.6	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	12.4		9.5		2.5	24.2	12.6	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.6	
BOQ	13.5		10.5		2.9	26.0	13.8	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.9		2.3	1.6	1.8	
BOQ	15.2		12.1		3.6	28.0	15.4	
QSRatio								
98th Percentile Output:								
fB%	2.0		2.1		2.8	1.7	2.0	
BOQ	16.8		13.6		4.3	30.0	17.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	283						771			544		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	662	1986	0.49	0.33	26.4	C	26.4	C

Westbound

Northbound

T 2134 3842 0.40 0.56 11.8 B 11.8 B

Southbound

T 1951 3512 0.31 0.56 11.2 B 11.2 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	283						771			544		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	80						212			153		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	322						847			611		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	283						771			544		
PHF	0.88						0.91			0.89		
Adj flow	322						847			611		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	322						847			611		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.971						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	1986						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	322	1986	# 0.16	0.33	662	0.49
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	847	3842	# 0.22	0.56	2134	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	611	3512	0.17	0.56	1951	0.31
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.38$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.43$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.49	0.33	23.9	1.000	662	0.50	2.5	0.0	26.4	C	26.4	C	
Westbound													
Northbound													
T	0.40	0.56	11.4	1.000	2134	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.31	0.56	10.8	1.000	1951	0.50	0.4	0.0	11.2	B	11.2	B	

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.9	0.00	0.0	0.0	26.4
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.4	0.00	0.0	0.0	11.8
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.8	0.00	0.0	0.0	11.2
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	322						444		320	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.49						0.40		0.31	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.4						6.3		4.3	
kB	0.9						0.9		1.1	
Q2	0.8						0.6		0.5	
Q Average	7.2						6.9		4.8	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	8.8						8.5		6.0	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.6						10.2		7.3	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	11.7						11.3		8.1	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.9		2.0	
BOQ	13.2						12.8		9.5	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.3	
BOQ	14.8						14.4		10.9	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					544	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					153	
Hourly Flow Rate, HFR					611	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						87
Peak Hour Factor, PHF						0.84
Peak-15 Minute Volume						26
Hourly Flow Rate, HFR						103
Percent Heavy Vehicles						29
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								306
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		306
Potential Capacity		675
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		675
Probability of Queue free St.	1.00	0.85

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	487
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	487
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	487	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	487	900

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	546
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	546

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						675
Volume						103
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								103
C(m) (vph)								675
v/c								0.15
95% queue length								0.54
Control Delay								11.3
LOS								B
Approach Delay							11.3	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	147	221	140	207	578	55	104	216	216	48	58	88
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left		P	
	Thru	P				Thru		P	
	Right	P				Right		P	
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		30.0					25.0	20.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	157	471	1.11	0.33	130.5	F		
TR	596	1788	0.66	0.33	30.4	C	61.3	E
Westbound								
L	180	541	1.28	0.33	188.6	F		
TR	1126	3378	0.61	0.33	27.4	C	67.8	E
Northbound								
LTR	914	3291	0.63	0.28	31.7	C	31.7	C
Southbound								
L	380	1711	0.16	0.22	29.1	C		
TR	351	1581	0.52	0.22	36.1	D	34.3	C

Intersection Delay = 53.7 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	147	221	140	207	578	55	104	216	216	48	58	88
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	66	42	58	161	15	28	58	58	15	18	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	175	392		230	689			576		60	182	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.194			0.000	
Prop RTs		0.329			0.068			0.403			0.604	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	147	221	140	207	578	55	104	216	216	48	58	88
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	175	263	129	230	642	47	112	232	232	60	72	110
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	175	392		230	689			576		60	182	
Prop LTs	1.000	0.000		1.000	0.000			0.194			0.000	
Prop RTs		0.329			0.068			0.403			0.604	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.943	0.943		0.962			0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.951			0.990		0.940				0.909	
fLT	0.259	1.000		0.323	1.000		0.990			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	471	1788		541	3378		3291			1711	1581	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	175	471	0.37	0.33	157	1.11
Prot							
Perm							
Thru	TR	392	1788	0.22	0.33	596	0.66
Right							
Westbound							
Prot							
Perm							
Left	L	230	541	# 0.43	0.33	180	1.28
Prot							
Perm							
Thru	TR	689	3378	0.20	0.33	1126	0.61
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	576	3291	# 0.18	0.28	914	0.63
Right							
Southbound							
Prot							
Perm							
Left	L	60	1711	0.04	0.22	380	0.16
Prot							
Perm							
Thru	TR	182	1581	# 0.12	0.22	351	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.72
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.11	0.33	30.0	1.000	157	0.50	100.5	0.0	130.5	F			
TR	0.66	0.33	25.6	1.000	596	0.50	4.8	0.0	30.4	C	61.3	E	
Westbound													
L	1.28	0.33	30.0	1.000	180	0.50	158.6	0.0	188.6	F			
TR	0.61	0.33	25.1	1.000	1126	0.50	2.3	0.0	27.4	C	67.8	E	
Northbound													
LTR	0.63	0.28	28.5	1.000	914	0.50	3.3	0.0	31.7	C	31.7	C	
Southbound													
L	0.16	0.22	28.2	1.000	380	0.50	0.9	0.0	29.1	C			
TR	0.52	0.22	30.8	1.000	351	0.50	5.3	0.0	36.1	D	34.3	C	

Intersection delay = 53.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	175	230		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	689	392		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.38	5.75		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.05	9.80		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.10	11.70		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.90	18.30		
n=Max(gq-gf)/2,0)	5.05	5.85		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.56	1.89		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.32		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.259	0.323		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.194 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.10			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.337			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	689			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.068
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	4.5	0.0	130.5
TR	0.0	0.00	30.0	25.6	0.00	0.0	0.0	30.4
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	12.5	0.0	188.6
TR	0.0	0.00	30.0	25.1	0.00	0.0	0.0	27.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.5	0.00	0.0	0.0	31.7
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	29.1
TR	0.0	0.00	35.0	30.8	0.00	0.0	0.0	36.1
	0.0						0.0	

Intersection Delay	53.7	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	175	392		230	361		302			60	182	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	471	1788		541	1774		1728			1711	1581	
LnCapacity	157	596		180	591		480			380	351	
Flow Ratio	0.4	0.2		0.4	0.2		0.2			0.0	0.1	
v/c Ratio	1.11	0.66		1.28	0.61		0.63			0.16	0.52	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.4	8.4		5.8	7.6		6.6			1.2	4.0	
kB	0.3	0.7		0.3	0.7		0.7			0.6	0.5	
Q2	3.8	1.2		7.5	1.1		1.1			0.1	0.6	
Q Average	8.2	9.6		13.2	8.7		7.7			1.3	4.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	10.0	11.7		16.0	10.5		9.4			1.7	5.7	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.5		1.5			1.6	1.5	
BOQ	11.9	13.9		18.8	12.6		11.3			2.1	6.9	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.6		1.5	1.6		1.6			1.9	1.7	
BOQ	13.0	15.1		20.3	13.8		12.4			2.5	7.8	
QSRatio												
95th Percentile Output:												
fB%	1.8	1.7		1.7	1.8		1.8			2.4	2.0	
BOQ	14.7	16.8		22.1	15.4		14.0			3.1	9.1	
QSRatio												
98th Percentile Output:												
fB%	2.0	1.9		1.8	2.0		2.0			2.9	2.3	
BOQ	16.3	18.5		23.9	17.0		15.6			3.8	10.5	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						405		
Peak-Hour Factor, PHF						0.87		
Hourly Flow Rate, HFR						465		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		130						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		139						
Percent Heavy Vehicles		4						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			139						
C(m) (vph)			552						
v/c			0.25						
95% queue length			0.99						
Control Delay			13.7						
LOS			B						
Approach Delay				13.7					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 405
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 116
 Hourly Flow Rate, HFR 465
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 130
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 35
 Hourly Flow Rate, HFR 139
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			465					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	465	
Potential Capacity	552	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	552	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 465
Potential Capacity 552
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 552

Results for Two-stage process:
a
y
C t 552

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	139					
Movement Capacity (vph)	552					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	552					
Volume	139					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			139					
C(m) (vph)			552					
v/c			0.25					
95% queue length			0.99					
Control Delay			13.7					
LOS			B					
Approach Delay				13.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	98	59	126	113	172	43	41	40	78	188	58
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.88	0.88	0.90	0.90	0.78	0.78	0.92	0.92
Flow Rate	72	122	202	254	107	51	186	165
% Heavy Veh	42	42	4	4	3	3	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	72	122	202	254	107	51	186	165
Left-Turn	17	0	140	0	55	0	84	0
Right-Turn	0	67	0	191	0	51	0	63
Prop. Left-Turns	0.2	0.0	0.7	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.5	0.0	0.8	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.8	0.3	0.4	-0.5	0.3	-0.6	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	72	122	202	254	107	51	186	165
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.06	0.11	0.18	0.23	0.10	0.05	0.17	0.15
hd, final value	7.50	7.00	6.74	5.87	7.18	6.22	6.79	6.30
x, final value	0.15	0.24	0.38	0.41	0.21	0.09	0.35	0.29
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.2	4.7	4.4	3.6	4.9	3.9	4.5	4.0

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	72	122	202	254	107	51	186	165
Service Time	5.2	4.7	4.4	3.6	4.9	3.9	4.5	4.0
Utilization, x	0.15	0.24	0.38	0.41	0.21	0.09	0.35	0.29
Dep. headway, hd	7.50	7.00	6.74	5.87	7.18	6.22	6.79	6.30
Capacity	322	372	452	504	357	301	436	415
Delay	11.52	11.86	13.49	12.66	11.82	9.52	13.12	11.54
LOS	B	B	B	B	B	A	B	B
Approach:								
Delay	11.74		13.03		11.08		12.37	
LOS	B		B		B		B	
Intersection Delay	12.35				Intersection LOS B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	60	117	280	219	385	18	243	196	86	22	518	219
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 818 3199 0.66 0.26 33.8 C 33.8 C

Westbound

LTR 878 3437 0.79 0.26 37.8 D 37.8 D

Northbound

DefL 100 311 2.79 0.32 863.1 F
 TR 586 1819 0.55 0.32 28.9 C 414.9 F

Southbound

LTR 856 2657 0.98 0.32 57.6 E 57.6 E

Intersection Delay = 128.1 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60	117	280	219	385	18	243	196	86	22	518	219
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	35	83	61	107	5	70	56	25	6	144	61
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		543			691		279	324			843	
%InSharedLn												
Prop LTs		0.131			0.352		1.000	0.000			0.028	
Prop RTs		0.613			0.029			0.306			0.288	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60	117	280	219	385	18	243	196	86	22	518	219
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	71	139	333	243	428	20	279	225	99	24	576	243
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	543			691			279 324			843		
Prop LTs	0.131			0.352			1.000 0.000			0.028		
Prop RTs	0.613			0.029			0.306			0.288		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.908			0.996			0.954			0.957		
fLT	0.994			0.983			0.163 1.000			0.938		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3199			3437			311 1819			2657		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	543	3199	# 0.17	0.26	818	0.66
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	691	3437	# 0.20	0.26	878	0.79
Right							
Northbound							
Prot							
Perm							
Left	DefL	279	311	# 0.90	0.32	100	2.79
Prot							
Perm							
Thru	TR	324	1819	0.18	0.32	586	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	843	2657	0.32	0.32	856	0.98
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.27
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.52

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.66	0.26	30.0	1.000	818	0.50	3.8	0.0	33.8	C	33.8	C	
Westbound													
LTR	0.79	0.26	31.2	1.000	878	0.50	6.6	0.0	37.8	D	37.8	D	
Northbound													
DefL	2.79	0.32	30.5	1.000	100	0.50	832.6	0.0	863.1	F			
TR	0.55	0.32	25.2	1.000	586	0.50	3.7	0.0	28.9	C	414.9	F	
Southbound													
LTR	0.98	0.32	30.3	1.000	856	0.50	27.3	0.0	57.6	E	57.6	E	

Intersection delay = 128.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			279	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			843	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.98	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.07	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			14.90	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.10	
n=Max(gq-gf)/2,0)			7.45	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.98	
EL2=Max((1-Ptho*n)/Plto, 1.0)			6.80	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			14.90	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.16	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.163	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	24
Proportion of LT in LT lane group, PLT	0.131 0.352 0.000 0.028
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	324
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.60
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.05
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	1.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.27
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06
EL1 (refer to Exhibit C16-3)	1.93
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				1.03
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.036
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				324
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.028
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.613	0.029	0.306
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	30.0	0.00	0.0	0.0	33.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	31.2	0.00	0.0	0.0	37.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	44.8	0.0	863.1
TR	0.0	0.00	30.5	25.2	0.00	0.0	0.0	28.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.3	0.00	0.0	0.0	57.6
	0.0						0.0	
Intersection Delay			128.1	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	285		362		279	324	442	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1680		1805		311	1819	1395	
LnCapacity	429		461		100	586	449	
Flow Ratio	0.2		0.2		0.9	0.2	0.3	
v/c Ratio	0.66		0.79		2.79	0.55	0.98	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.889		0.932			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.4		8.4		7.0	6.7	11.0	
kB	0.6		0.6		0.2	0.8	0.7	
Q2	1.1		2.0		22.7	0.9	5.6	
Q Average	7.4		10.4		29.7	7.6	16.6	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	9.1		12.6		35.6	9.3	19.9	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.4	1.5	1.4	
BOQ	10.9		14.9		41.6	11.2	23.4	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.5	1.6	1.5	
BOQ	12.0		16.2		44.6	12.3	25.1	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.7		1.6	1.8	1.6	
BOQ	13.6		17.9		47.6	13.9	27.1	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.9		1.7	2.0	1.8	
BOQ	15.2		19.6		50.6	15.5	29.0	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/27/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	658	393	3	1	413	621	0	0	1	105	0	130
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	783	1711	0.92	0.71	35.0+	D		
TR	1158	1628	0.38	0.71	5.8	A	24.0	C
Westbound								
LT	451	1843	1.01	0.24	67.5	E	261.6	F
R	383	1568	1.78	0.24	391.1	F		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.46	0.18	39.7	D		
LT	320	1801	0.00	0.18	30.4	C	21.3	C
R	952	1478	0.14	0.64	6.6	A		

Intersection Delay = 130.1 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/27/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	658	393	3	1	413	621	0	0	1	105	0	130
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	181	108	1	1	113	171	0	0	1	27	0	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	723	435			455	682		4		108	0	134
%InSharedLn										0		
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	658	393	3	1	413	621	0	0	1	105	0	130
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	723	432	3	1	454	682	0	0	4	108	0	134
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	723	435			455	682		4		108	0	134
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.007			0.000	1.000		1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.980	0.980		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.865				1.000	0.850
fLT	0.950	1.000		0.999			1.000			0.755	1.000	
Sec.	0.148											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1711	1628		1843	1568		1844			1313	1801	1478
Sec.	267											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		703	1711	# 0.41	0.411	703	1.00
Perm		20	267	0.07	0.300	80	0.25
Left	L	723			0.71	783	0.92
Prot							
Perm							
Thru	TR	435	1628	0.27	0.71	1158	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	455	1843	0.25	0.24	451	1.01
Right	R	682	1568	# 0.43	0.24	383	1.78
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	108	1313	# 0.08	0.18	233	0.46
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	134	1478	0.09	0.64	952	0.14

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.11

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.92	0.71	20.6	1.000	783	0.50	14.4	0.0	35.0+	D			
TR	0.38	0.71	5.1	1.000	1158	0.50	0.7	0.0	5.8	A	24.0	C	
Westbound													
LT	1.01	0.24	34.0	1.000	451	0.50	33.5	0.0	67.5	E	261.6	F	
R	1.78	0.24	34.0	1.000	383	0.50	357.1	0.0	391.1	F			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.46	0.18	33.2	1.000	233	0.50	6.5	0.0	39.7	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	21.3	C	

R 0.14 0.64 6.3 1.000 952 0.50 0.3 0.0 6.6 A

Intersection delay = 130.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	723			108
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	455			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLT/3600	18.08			2.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.38			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	23.00			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.00			16.00
n=Max(gq-gf)/2,0)	11.50			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.00			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	11.37			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	23.00			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	435	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.88	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		2.16	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdif=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		435		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.007
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	723			
v/c ratio from Capacity Worksheet, X	0.92			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	19.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	30.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.43			
XPerm	2.71			
XProt	0.77			
Case	3			
Queue at beginning of green arrow, Qa	8.94			
Queue at beginning of unsaturated green, Qu	3.82			
Residual queue, Qr	2.91			
Uniform Delay, d1	20.6			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		20.6	0.00	0.0	0.0	35.0+
TR	0.0	0.00	13.0	5.1	0.00	0.0	0.0	5.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	34.0	0.00	1.0	0.0	67.5
R	0.0	0.00	34.0	34.0	0.00	74.8	0.0	391.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.2	0.00	0.0	0.0	39.7
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.6

Intersection Delay	130.1	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	723	435		455	682	4		108	0	134
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1102	1628		1843	1568	1844		1313	1801	1478
LnCapacity	783	1158		451	383	328		233	320	952
Flow Ratio	0.7	0.3		0.2	0.4	0.0		0.1	0.0	0.1
v/c Ratio	0.92	0.38		1.01	1.78	0.01		0.46	0.00	0.14
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	8.4	4.3		11.4	17.0	0.1		2.4	0.0	1.3
kB	0.7	0.9		0.4	0.3	0.5		0.4	0.5	1.1
Q2	5.1	0.6		4.8	38.1	0.0		0.3	0.0	0.2
Q Average	13.5	4.8		16.1	55.1	0.1		2.8	0.0	1.5
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	16.3	6.0		19.4	66.2	0.1		3.5	0.0	1.9
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4	1.7		1.6	1.7	1.6
BOQ	19.2	7.3		22.8	77.2	0.2		4.4	0.0	2.4
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5	2.0		1.8	2.0	1.9
BOQ	20.7	8.2		24.5	82.7	0.2		4.9	0.0	2.8
QSRatio										
95th Percentile Output:										
fB%	1.7	2.0		1.6	1.6	2.6		2.2	2.6	2.3
BOQ	22.5	9.6		26.5	88.2	0.2		6.0	0.0	3.5
QSRatio										
98th Percentile Output:										
fB%	1.8	2.3		1.8	1.7	3.2		2.6	3.2	2.8
BOQ	24.3	11.0		28.4	93.7	0.3		7.1	0.0	4.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2015 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	461	36	0	2	62	69	4	3	0	62	6	969
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	P				NB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
WB	Left	P				SB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		45.0						35.0			
Yellow		3.0						3.0			
All Red		2.0						2.0			

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	709	1418	0.72	0.50	23.4	C		
TR	1056	2111	0.04	0.50	11.5	B	22.5	C

LT	541	1390	0.14	0.39	18.3	B	133.7	F
R	593	1524	1.23	0.39	145.7	F		

Intersection Delay = 81.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	461	36	0	2	62	69	4	3	0	62	6	969	
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6	
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90	
PK 15 Vol	127	10	0	1	17	19	2	1	0	17	2	269	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900		1900	1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0	
RTOR Vol			0			17			0			310	
Adj Flow	507	40			127		7	5			76	732	
%InSharedLn													
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908		
Prop RTs		0.000			0.449			0.000			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0		0	0			0	0	
%InProtPhase													
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	461	36	0	2	62	69	4	3	0	62	6	969
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	507	40	0	2	68	57	7	5	0	69	7	732
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	507	40			127		7	5			76	732
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908	
Prop RTs		0.000			0.449			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.933				1.000		1.000	0.850	
fLT	0.672	1.000		0.954			0.708	1.000		0.775		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1418	2111		3072			1331	1881		1390	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	507	1418	# 0.36	0.50	709	0.72
Prot							
Perm							
Thru	TR	40	2111	0.02	0.50	1056	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	127	3072	0.04	0.50	1536	0.08
Right							
Northbound							
Prot							
Perm							
Left	DefL	7	1331	0.01	0.39	518	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	76	1390	0.05	0.39	541	0.14
Right	R	732	1524	# 0.48	0.39	593	1.23

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.84$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.94$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.72	0.50	17.5	1.000	709	0.50	5.9	0.0	23.4	C		
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	22.5	C
Westbound												
LTR	0.08	0.50	11.7	1.000	1536	0.50	0.1	0.0	11.8	B	11.8	B
Northbound												
DefL	0.01	0.39	16.9	1.000	518	0.50	0.0	0.0	16.9	B		
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.14	0.39	17.8	1.000	541	0.50	0.5	0.0	18.3	B	133.7	F

R 1.23 0.39 27.5 1.000 593 0.50 118.2 0.0 145.7 F

Intersection delay = 81.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	507		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	127		76	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/C	12.68		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.67		1.90	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.41	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.672		0.708	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	69
Proportion of LT in LT lane group, PLT	0.000	0.016 0.000 0.908
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	40	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.73
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.50
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.775

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	127	40	76	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.016	1.000	0.908
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.449	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	17.5	0.00	0.0	0.0	23.4
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.7	0.00	0.0	0.0	11.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	27.5	27.5	0.00	34.8	0.0	145.7
Intersection Delay			81.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	507	40			66		7	5		76	732	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1418	2111			1613		1331	1881		1390	1524	
LnCapacity	709	1056			806		518	732		541	593	
Flow Ratio	0.4	0.0			0.0		0.0	0.0		0.1	0.5	
v/c Ratio	0.72	0.04			0.08		0.01	0.01		0.14	1.23	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	9.9	0.5			0.9		0.1	0.1		1.2	18.3	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	2.0	0.0			0.1		0.0	0.0		0.1	20.5	
Q Average	11.9	0.6			0.9		0.1	0.1		1.3	38.8	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	14.4	0.7			1.2		0.2	0.1		1.7	46.6	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	17.0	0.9			1.6		0.2	0.1		2.2	54.3	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	18.4	1.1			1.8		0.2	0.2		2.5	58.2	
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.4		2.6	2.6		2.4	1.6	
BOQ	20.1	1.4			2.3		0.3	0.2		3.2	62.1	
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			2.9		3.2	3.2		2.8	1.7	
BOQ	21.8	1.7			2.8		0.4	0.3		3.8	66.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	233		24				4	221		598	572	
Lane Width	13.0		12.0					11.5		16.0		
RTOR Vol			6								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.49	0.32	19.7	B	19.4	B
R	465	1468	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1651 3195 0.15 0.52 7.8 A 7.8 A

Southbound

TR 1925 3725 0.76 0.52 13.5 B 13.5 B

Intersection Delay = 13.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	233		24				4	221		598	572	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	66		7				1	61		187	179	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	265		20					250			1462	
%InSharedLn												
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.489	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975					0.998			0.686		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	233		24				4	221		598	572	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	265		20				4	246		747	715	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	265		20					250			1462	
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.489	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG								
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.909	0.909			0.962	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.927		
fLT	0.950				0.934	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1696	1468			3195	3725		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	265	1696	# 0.16	0.32	537	0.49
Prot							
Perm							
Thru							
Right	R	20	1468	0.01	0.32	465	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	250	3195	0.08	0.52	1651	0.15
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1462	3725	# 0.39	0.52	1925	0.76
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.49	0.32	16.6	1.000	537	0.50	3.1	0.0	19.7	B	19.4	B	
R	0.04	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B			
Westbound													
Northbound													
LT	0.15	0.52	7.6	1.000	1651	0.50	0.2	0.0	7.8	A	7.8	A	
Southbound													
TR	0.76	0.52	11.5	1.000	1925	0.50	2.0	0.0	13.5	B	13.5	B	

Intersection delay = 13.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.016 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1462
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.80
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	16.57
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	6.20
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			16.57	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.535	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1462	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.016	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.489
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	16.6	0.00	0.0	0.0	19.7
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.6	0.00	0.0	0.0	7.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.5	0.00	0.0	0.0	13.5
	0.0						0.0	
Intersection Delay			13.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	265	20				131		767	
So	1900	1900				1900		1900	
No.Lanes	1 0	1 0	0 0 0			2 0		2 0	
SL	1696	1468				1678		1956	
LnCapacity	537	465				867		1011	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.49	0.04				0.15		0.76	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	3.6	0.2				1.1		10.2	
kB	0.5	0.5				0.8		0.6	
Q2	0.5	0.0				0.1		1.8	
Q Average	4.1	0.3				1.3		11.9	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	5.1	0.3				1.6		14.4	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	6.3	0.4				2.1		17.0	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.5	
BOQ	7.0	0.5				2.4		18.4	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.6				2.4		1.7	
BOQ	8.4	0.6				3.0		20.2	
QSRatio									
98th Percentile Output:									
fB%	2.4	3.1				2.9		1.8	
BOQ	9.7	0.8				3.7		21.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		578	1		1			22	590	0
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	612	1468	0.50	0.42	15.7	B		
LT	587	1409	0.52	0.42	16.2	B	16.0	B

Northbound

L	215	515	0.00	0.42	10.3	B	10.3	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2040	4896	0.37	0.42	12.6	B	12.6	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		578	1		1			22	590	0
% Heavy Veh	1	1		1	1		1			2	2	2
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol	1	0		152	1		1			7	184	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			304	305		1			764		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.997		1.000				0.035	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.989		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		578	1		1			22	590	0
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	4	0		608	1		1			27	737	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			304	305		1			764		
Prop LTs	0.000			1.000 0.997			1.000			0.035		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.293		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1468 1409		515		4896	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	304	1468	0.21	0.42	612	0.50
Prot							
Perm							
Thru	LT	305	1409	# 0.22	0.42	587	0.52
Right							
Northbound							
Prot							
Perm							
Left	L	1	515	0.00	0.42	215	0.00
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	764	4896	# 0.16	0.42	2040	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.50	0.42	12.9	1.000	612	0.50	2.8	0.0	15.7	B		
LT	0.52	0.42	13.0	1.000	587	0.50	3.2	0.0	16.2	B	16.0	B
Northbound												
L	0.00	0.42	10.2	1.000	215	0.50	0.0	0.0	10.3	B	10.3	B
Southbound												
LTR	0.37	0.42	12.1	1.000	2040	0.50	0.5	0.0	12.6	B	12.6	B

Intersection delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		304	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		4	764	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		5.07	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	4.67	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	4.04	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	20.96	
n=Max(gq-gf)/2,0)		0.00	2.02	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.86	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.98	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	4.04	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.293	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	304		
Proportion of LT in LT lane group, PLT	0.000	0.997	0.035
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.07		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00-		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.725		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		304	305	1		280	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1468	1409	515		1797	
LnCapacity	784		612	587	215		748	
Flow Ratio	0.0		0.2	0.2	0.0		0.2	
v/c Ratio	0.01		0.50	0.52	0.00		0.37	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.983		0.989	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.7	3.8	0.0		3.2	
kB	0.7		0.6	0.6	0.3		0.7	
Q2	0.0		0.6	0.6	0.0		0.4	
Q Average	0.0		4.3	4.4	0.0		3.6	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.2	
BOQ	0.1		5.4	5.5	0.0		4.5	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.5	
BOQ	0.1		6.6	6.7	0.0		5.6	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.7	
BOQ	0.1		7.4	7.5	0.0		6.3	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.0	2.0	2.6		2.1	
BOQ	0.1		8.7	8.9	0.0		7.6	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.3	2.3	3.2		2.4	
BOQ	0.1		10.1	10.2	0.0		8.8	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	23
Peak-Hour Factor, PHF	0.55
Hourly Flow Rate, HFR	41
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	452
Peak Hour Factor, PHF	0.90
Hourly Flow Rate, HFR	502
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	502
C(m) (vph)	1033
v/c	0.49
95% queue length	2.72
Control Delay	11.7
LOS	B
Approach Delay	11.7
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Englewood Ave & Vets Rd W RT
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Englewood Avenue
North/South Street: Veterans Rd W Right Turn Bay
Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.55				
Peak-15 Minute Volume		10				
Hourly Flow Rate, HFR		41				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			452			
Peak Hour Factor, PHF			0.90			
Peak-15 Minute Volume			126			
Hourly Flow Rate, HFR			502			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					41			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	41	
Potential Capacity	1033	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1033	
Probability of Queue free St.	0.51	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.51
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.51
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			502			
Movement Capacity (vph)			1033			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1033			
Volume			502			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					502			
C(m) (vph)					1033			
v/c					0.49			
95% queue length					2.72			
Control Delay					11.7			
LOS					B			
Approach Delay				11.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	53	30	198	57	0	0	0	0	30	76	20
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.86		0.77				0.80 0.80	
Flow Rate	95		331				84 71	
% Heavy Veh	17		4				1 1	
No. Lanes	1		1				2	
Opposing-Lanes	1		1				0	
Conflicting-lanes	2		2				1	
Geometry group	2		2				1	
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	95		331				84 71	
Left-Turn	0		257				37 0	
Right-Turn	34		0				0 24	
Prop. Left-Turns	0.0		0.8				0.4 0.0	
Prop. Right-Turns	0.4		0.0				0.0 0.3	
Prop. Heavy Vehicle	0.2		0.0				0.0 0.0	
Geometry Group	2		2				1	
Adjustments Exhibit 17-33:								
hLT-adj	0.2		0.2				0.2	

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	39	45	0	0	214	22	41	61	86	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	97		305		80		132	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	97		305		80	132		
Left-Turn	45		0		46	0		
Right-Turn	0		28		0	97		
Prop. Left-Turns	0.5		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	145	191	139	2	37	5	542	37	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	571	1631	0.65	0.35	21.9	C	20.3	C
R	560	1599	0.17	0.35	14.1	B		

Westbound

LTR	530	1514	0.09	0.35	13.4	B	13.4	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2286	4730	0.26	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	145	191	139	2	37	5	542	37	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	40	52	38	1	10	2	140	10	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		369	96		46			599				
%InSharedLn												
Prop LTs		0.431			0.043			0.933				
Prop RTs		0.000	1.000		0.109			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	145	191	139	2	37	5	542	37	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	159	210	96	2	39	5	559	38	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	369 96			46			599					
Prop LTs	0.431			0.043			0.933					
Prop RTs	0.000 1.000			0.109			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.952			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.985			0.999	
fLT	0.839			0.987			0.955	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1631	1599		1514			4730	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.65	0.35	16.4	1.000	571	0.50	5.6	0.0	21.9	C	20.3	C
R	0.17	0.35	13.5	1.000	560	0.50	0.7	0.0	14.1	B		
Westbound												
LTR	0.09	0.35	13.1	1.000	530	0.50	0.3	0.0	13.4	B	13.4	B
Northbound												
LTR	0.26	0.48	9.2	1.000	2286	0.50	0.3	0.0	9.4	A	9.4	A
Southbound												

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	159	2	
Proportion of LT in LT lane group, PLT	0.431	0.043	0.933
Proportion of LT in opposing flow, PLTo	0.04	0.43	
Adjusted opposing flow rate, Vo (veh/h)	46	369	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.65	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	6.15	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	7.49	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.96	0.57	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.43	0.04	
EL1 (refer to Exhibit C16-3)	1.44	2.02	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.84	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.839	0.987	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	7.49		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.357		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	46	369	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.431	0.043	0.933	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.109	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	16.4	0.00	0.0	0.0	21.9
R	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound		
LaneGroup	LT	R	LTR	LTR				
Init Queue	0.0	0.0	0.0	0.0				
Flow Rate	369	96	46	219				
So	1900	1900	1900	1900				
No.Lanes	0 1	1	0 1	0 3	0	0	0	0
SL	1631	1599	1514	1736				
LnCapacity	571	560	530	839				
Flow Ratio	0.2	0.1	0.0	0.1				
v/c Ratio	0.65	0.17	0.09	0.26				
Grn Ratio	0.35	0.35	0.35	0.48				
I Factor	0.999		0.999	0.980				
AT or PVG	3	3	3	3				
Pltn Ratio	1.00	1.00	1.00	1.00				
PF2	1.00	1.00	1.00	1.00				
Q1	5.2	1.1	0.5	2.2				
kB	0.6	0.6	0.6	0.7				
Q2	1.0	0.1	0.1	0.3				
Q Average	6.2	1.2	0.6	2.4				
Q Spacing	25.0	25.0	25.0	25.0				
Q Storage	0	0	0	0				
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3	1.3				
BOQ	7.6	1.6	0.7	3.1				
QSRatio								
85th Percentile Output:								
fB%	1.5	1.6	1.7	1.6				
BOQ	9.2	2.0	0.9	3.8				
QSRatio								
90th Percentile Output:								
fB%	1.6	1.9	1.9	1.8				
BOQ	10.2	2.3	1.1	4.4				
QSRatio								
95th Percentile Output:								
fB%	1.9	2.4	2.5	2.2				
BOQ	11.7	2.9	1.4	5.4				
QSRatio								
98th Percentile Output:								
fB%	2.1	2.9	3.0	2.6				
BOQ	13.2	3.5	1.7	6.4				
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	154		39				14	283		333	31	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 465 1745 0.51 0.27 22.6 C 22.6 C

Westbound

Northbound

LT 1092 1927 0.31 0.57 7.6 A 7.6 A

Southbound

TR 1173 2070 0.34 0.57 7.7 A 7.7 A

Intersection Delay = 11.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	154		39				14	283		333	31	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	48		12				4	81		91	9	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		238						341			400	
%InSharedLn												
Prop LTs		0.798						0.047			0.000	
Prop RTs		0.202						0.000			0.085	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	154		39				14	283		333	31	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	190		48				16	325		366	34	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		238						341			400	
Prop LTs		0.798						0.047			0.000	
Prop RTs	0.202						0.000			0.085		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.973						1.000			0.989		
fLT	0.962						0.978			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1745						1927			2070		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	238	1745	# 0.14	0.27	465	0.51
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	341	1927	0.18	0.57	1092	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	400	2070	# 0.19	0.57	1173	0.34
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.33$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.40$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.51	0.27	18.7	1.000	465	0.50	3.9	0.0	22.6	C	22.6	C
Westbound												
Northbound												
LT	0.31	0.57	6.8	1.000	1092	0.50	0.7	0.0	7.6	A	7.6	A
Southbound												
TR	0.34	0.57	7.0	1.000	1173	0.50	0.8	0.0	7.7	A	7.7	A

Intersection delay = 11.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		16	
Proportion of LT in LT lane group, PLT	0.798	0.047	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		400	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.27	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.67	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		3.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.62	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.08	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.978	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			3.64	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.107	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			400	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.047	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.085
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.7	0.00	0.0	0.0	22.6
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	6.8	0.00	0.0	0.0	7.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.0	0.00	0.0	0.0	7.7
	0.0						0.0	
Intersection Delay			11.3	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	238						341			400		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1745						1927			2070		
LnCapacity	465						1092			1173		
Flow Ratio	0.1						0.2			0.2		
v/c Ratio	0.51						0.31			0.34		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.4						3.0			3.6		
kB	0.5						0.9			0.9		
Q2	0.5						0.4			0.5		
Q Average	3.9						3.4			4.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.3			1.2		
BOQ	4.8						4.2			5.0		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.6			1.5		
BOQ	6.0						5.3			6.2		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.8			1.7		
BOQ	6.7						5.9			7.0		
QSRatio												
95th Percentile Output:												
fB%	2.1						2.1			2.0		
BOQ	8.0						7.1			8.3		
QSRatio												
98th Percentile Output:												
fB%	2.4						2.5			2.4		
BOQ	9.3						8.3			9.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	78		52				43	394		282	193	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 555 1664 0.27 0.33 15.9 B 15.9 B

Westbound

Northbound

LT 844 1687 0.59 0.50 13.5 B 13.5 B

Southbound

TR 1002 2004 0.51 0.50 11.8 B 11.8 B

Intersection Delay = 13.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	78		52				43	394		282	193	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	23		15				12	113		77	53	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		151						502			507	
%InSharedLn												
Prop LTs		0.603						0.098			0.000	
Prop RTs		0.397						0.000			0.389	
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	78		52				43	394		282	193	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	91		60				49	453		310	197	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		151						502			507	
Prop LTs		0.603						0.098			0.000	
Prop RTs	0.397						0.000			0.389		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.946						1.000			0.948		
fLT	0.971						0.921			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1664						1687			2004		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	151	1664	# 0.09	0.33	555	0.27
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	502	1687	# 0.30	0.50	844	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	507	2004	0.25	0.50	1002	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.27	0.33	14.7	1.000	555	0.50	1.2	0.0	15.9	B	15.9	B
Westbound												
Northbound												
LT	0.59	0.50	10.7	1.000	844	0.50	2.8	0.0	13.5	B	13.5	B
Southbound												
TR	0.51	0.50	10.0	1.000	1002	0.50	1.7	0.0	11.8	B	11.8	B

Intersection delay = 13.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gq > gf$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		49	
Proportion of LT in LT lane group, PLT	0.603	0.098	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		507	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.82	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.45	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		7.05	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		20.93	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.10	
EL1 (refer to Exhibit C16-3)		2.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.921	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			7.05	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.235	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		507	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.603		0.098	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.397	0.389
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	14.7	0.00	0.0	0.0 0.0 0.0	15.9
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	10.7	0.00	0.0	0.0 0.0 0.0	13.5
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	10.0	0.00	0.0	0.0 0.0 0.0	11.8
Intersection Delay			13.0	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	151						502			507		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1664						1687			2004		
LnCapacity	555						844			1002		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.27						0.59			0.51		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.8						6.0			5.7		
kB	0.6						0.7			0.8		
Q2	0.2						1.0			0.8		
Q Average	2.1						6.9			6.5		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.6						8.5			8.0		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.3						10.2			9.6		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.8						11.3			10.6		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.8			1.9		
BOQ	4.6						12.8			12.2		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.1			2.1		
BOQ	5.5						14.4			13.7		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	9		132	222	455	123	95	164		341	31	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.05	0.13	23.1	C	43.5	D
R	220	1652	0.78	0.13	44.9	D		
Westbound								
LTR	1339	4727	0.69	0.28	21.2	C	21.2	C
Northbound								
L	171	514	0.63	0.33	32.0	C		
T	593	1778	0.31	0.33	16.1	B	22.0	C
Southbound								
TR	690	2071	0.60	0.33	19.8	B	19.8	B

Intersection Delay = 23.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9		132	222	455	123	95	164		341	31	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		43	64	131	35	27	46		95	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	12		171		919		107	184			413	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000			0.082	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds	X	
WB	Left			P			SB	Left		
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds			X				Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		8.0	17.0					20.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9		132	222	455	123	95	164		341	31	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	12		171	255	523	141	107	184		379	34	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	12		171		919		107	184			413	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000			0.082	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.943	0.943	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.977	0.977		1.000	0.989	0.989
fLT	0.950		0.986	0.986	0.287	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4727	4727	514	1778	2071	2071
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	12	1668	0.01	0.13	222	0.05
Prot							
Perm							
Thru							
Right	R	171	1652	# 0.10	0.13	220	0.78
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	919	4727	# 0.19	0.28	1339	0.69
Right							
Northbound							
Prot							
Perm							
Left	L	107	514	# 0.21	0.33	171	0.63
Prot							
Perm							
Thru	T	184	1778	0.10	0.33	593	0.31
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	413	2071	0.20	0.33	690	0.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.05	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	43.5	D	
R	0.78	0.13	25.1	1.000	220	0.50	19.8	0.0	44.9	D			
Westbound													
LTR	0.69	0.28	19.1	1.000	1339	0.50	2.1	0.0	21.2	C	21.2	C	
Northbound													
L	0.63	0.33	16.8	1.000	171	0.50	15.1	0.0	32.0	C	22.0	C	
T	0.31	0.33	14.9	1.000	593	0.50	1.3	0.0	16.1	B			
Southbound													
TR	0.60	0.33	16.7	1.000	690	0.50	3.1	0.0	19.8	B	19.8	B	

Intersection delay = 23.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			107	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			413	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.78	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.88	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			8.98	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.02	
n=Max(gq-gf)/2,0)			4.49	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.92	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.287	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			8.98	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.449	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			413	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)		17.0		20.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		17.0		20.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.153	0.082
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	25.1	0.00	0.0	0.0	44.9
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.1	0.00	0.0	0.0	21.2
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.8	0.00	0.0	0.0	32.0
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.7	0.00	0.0	0.0	19.8
	0.0						0.0	
Intersection Delay			23.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	12	171		337		107	184		413
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1735		514	1778		2071
LnCapacity	222	220		491		171	593		690
Flow Ratio	0.0	0.1		0.2		0.2	0.1		0.2
v/c Ratio	0.05	0.78		0.69		0.63	0.31		0.60
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	2.8		5.0		1.5	2.3		5.7
kB	0.2	0.2		0.4		0.2	0.6		0.5
Q2	0.0	0.8		0.8		0.4	0.3		0.8
Q Average	0.2	3.5		5.8		1.9	2.5		6.5
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.2	4.4		7.1		2.4	3.2		8.0
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.5
BOQ	0.3	5.5		8.7		3.0	4.0		9.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.7		1.8	1.8		1.6
BOQ	0.4	6.2		9.6		3.5	4.6		10.7
QSRatio									
95th Percentile Output:									
fB%	2.6	2.1		1.9		2.3	2.2		1.9
BOQ	0.5	7.4		11.1		4.3	5.6		12.2
QSRatio									
98th Percentile Output:									
fB%	3.1	2.4		2.2		2.7	2.6		2.1
BOQ	0.6	8.6		12.6		5.1	6.6		13.7
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	15	7				6	254	109	222	445	27
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 456 1611 0.09 0.28 16.2 B 16.2 B

Westbound

Northbound

LTR 925 1681 0.45 0.55 9.5 A 9.5 A

Southbound

L 532 967 0.46 0.55 10.4 B
 TR 1018 1850 0.51 0.55 9.9 A 10.1 B

Intersection Delay = 10.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	15	7				6	254	109	222	445	27
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	71	31	62	124	8
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		43						414		247	524	
%InSharedLn												
Prop LTs		0.186						0.017		1.000	0.000	
Prop RTs		0.256						0.295			0.057	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	5	15	7						6	254	109		222	445	27
PHF	0.63	0.63	0.63						0.89	0.89	0.89		0.90	0.90	0.90
Adj flow	8	24	11						7	285	122		247	494	30
No. Lanes	0	1	0		0	0	0		0	1	0		1	1	0
Lane group	LTR								LTR				L	TR	
Adj flow	43								414				247	524	
Prop LTs	0.186								0.017				1.000	0.000	
Prop RTs	0.256								0.295				0.057		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L TR		
So	1900						1900			1900 1900		
Lanes 0	1	0	0	0	0	0	1	0		1	1	0
fW	1.033						1.133			1.000 1.000		
fHV	0.980						0.943			0.990 0.990		
fG	1.000						1.000			1.000 1.000		
fP	0.875						0.875			1.000 1.000		
fBB	1.000						0.992			1.000 0.992		
fA	1.000						1.000			1.000 1.000		
fLU	1.000						1.000			1.000 1.000		
fRT	0.965						0.960			0.991		
fLT	0.991						0.993			0.514 1.000		
Sec.												
fLpb	1.000						1.000			1.000 1.000		
fRpb	1.000						1.000			1.000		
S	1611						1681			967 1850		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	43	1611	# 0.03	0.28	456	0.09
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	414	1681	0.25	0.55	925	0.45
Right							
Southbound							
Prot							
Perm							
Left	L	247	967	0.26	0.55	532	0.46
Prot							
Perm							
Thru	TR	524	1850	# 0.28	0.55	1018	0.51
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.31$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.37$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.28	15.8	1.000	456	0.50	0.4	0.0	16.2	B	16.2	B
Westbound												
Northbound												
LTR	0.45	0.55	8.1	1.000	925	0.50	1.5	0.0	9.5	A	9.5	A
Southbound												
L	0.46	0.55	8.2	1.000	532	0.50	2.3	0.0	10.4	B		
TR	0.51	0.55	8.5	1.000	1018	0.50	1.5	0.0	9.9	A	10.1	B

Intersection delay = 10.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				247
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				414
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.12
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.90
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.77
n=Max(gq-gf)/2,0)				2.12
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.92
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.10
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdiff=max(gq-gf,0)				4.23
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.51
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.514

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	7
Proportion of LT in LT lane group, PLT	0.186
Proportion of LT in opposing flow, PLTo	0.017 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	524
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.12
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	6.05
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02
EL1 (refer to Exhibit C16-3)	2.35
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.993

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.05	4.23
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.183	0.128
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			524	414
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.017	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.256	0.295	0.057
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.8	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.1	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.2	0.00	0.0	0.0	10.4
TR	0.0	0.00	13.5	8.5	0.00	0.0	0.0	9.9
	0.0						0.0	
Intersection Delay			10.1	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		43						414			247	524
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1611						1681			967	1850
LnCapacity		456						925			532	1018
Flow Ratio		0.0						0.2			0.3	0.3
v/c Ratio		0.09						0.45			0.46	0.51
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.932				0.785
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.5						4.1			2.5	5.5
kB		0.5						0.8			0.4	0.7
Q2		0.1						0.6			0.4	0.7
Q Average		0.6						4.7			2.9	6.2
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.3	1.2
BOQ		0.7						5.9			3.6	7.6
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.6	1.5
BOQ		1.0						7.2			4.5	9.2
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.8	1.6
BOQ		1.1						8.0			5.1	10.2
QSRatio												
95th Percentile Output:												
fB%		2.5						2.0			2.2	1.9
BOQ		1.4						9.4			6.2	11.7
QSRatio												
98th Percentile Output:												
fB%		3.0						2.3			2.5	2.1
BOQ		1.8						10.8			7.3	13.2
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	5	7	17	257	25	102	21	262	165	87	346	19
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 626 1408 0.06 0.44 14.4 B 14.4 B

Westbound

L 548 1232 0.56 0.44 21.9 C
 T 763 1717 0.04 0.44 14.2 B 19.8 B
 R 563 1266 0.21 0.44 16.1 B

Northbound

LTR 692 1557 0.73 0.44 24.9 C 24.9 C

Southbound

LTR 635 1429 0.79 0.44 27.9 C 27.9 C

Intersection Delay = 24.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	7	17	257	25	102	21	262	165	87	346	19
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	2	5	76	7	30	6	74	46	24	96	5
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		37		306	30	121		503			502	
%InSharedLn												
Prop LTs		0.162		1.000	0.000			0.048			0.193	
Prop RTs		0.595			0.000	1.000		0.368			0.042	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.830			0.650			0.650	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	7	17	257	25	102	21	262	165	87	346	19
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	9	22	306	30	121	24	294	185	97	384	21
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	37			306	30	121	503			502		
Prop LTs	0.162			1.000	0.000		0.048			0.193		
Prop RTs	0.595			0.000 1.000			0.368			0.042		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.935	0.935	0.935	0.943		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.920		1.000 0.850			0.950		0.994		
fLT	0.979		0.733	1.000		0.966		0.775		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.996		
fRpb	0.967		1.000 1.000			0.979		1.000		
S	1408		1232	1717	1266	1557		1429		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	37	1408	0.03	0.44	626	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	306	1232	# 0.25	0.44	548	0.56
Prot							
Perm							
Thru	T	30	1717	0.02	0.44	763	0.04
Right	R	121	1266	0.10	0.44	563	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	503	1557	0.32	0.44	692	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	502	1429	# 0.35	0.44	635	0.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	626	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.56	0.44	18.5	1.000	548	0.50	3.4	0.0	21.9	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	19.8	B
R	0.21	0.44	15.4	1.000	563	0.50	0.7	0.0	16.1	B		
Northbound												
LTR	0.73	0.44	20.5	1.000	692	0.50	4.3	0.0	24.9	C	24.9	C
Southbound												
LTR	0.79	0.44	21.4	1.000	635	0.50	6.5	0.0	27.9	C	27.9	C

Intersection delay = 24.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		37		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.733		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	6	24	97
Proportion of LT in LT lane group, PLT	0.162	0.000	0.048
Proportion of LT in opposing flow, PLTo	0.00	0.19	0.05
Adjusted opposing flow rate, Vo (veh/h)	30	502	503
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.15	0.60	2.42
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.75	12.55	12.57
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	16.4	3.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	13.21	13.24
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	23.56	26.76
n=Max(gq-gf)/2,0)	0.00	0.00	4.66
PTHo=1-PLTo	1.00	0.81	0.95
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.05	0.19
EL1 (refer to Exhibit C16-3)	1.42	2.30	2.31
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.27
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	9.32
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.979	0.966	0.775

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	13.21	13.24
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.330	0.331
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	30	37	502	503
OCCr	0.000	0.053	0.000	0.023
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.977
Proportion of left turns, PLT	0.162	1.000	0.048	0.193
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.595	1.000	0.368	0.042
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.967	1.000	0.979	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.4
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.5	0.00	0.0	0.0	21.9
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.4	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.5	0.00	0.0	0.0	24.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.4	0.00	0.0	0.0	27.9
	0.0						0.0	
Intersection Delay			24.1	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		37	306	30	121		503		502
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1408	1232	1717	1266		1557		1429
LnCapacity		626	548	763	563		692		635
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.06	0.56	0.04	0.21		0.73		0.79
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.830			0.650		0.650
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.5	5.7	0.4	1.9		10.3		10.7
kB		0.8	0.6	0.8	0.6		0.6		0.5
Q2		0.1	0.8	0.0	0.2		1.4		1.8
Q Average		0.6	6.4	0.5	2.0		11.8		12.6
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.7	7.9	0.6	2.6		14.2		15.2
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.0	9.5	0.8	3.2		16.8		17.9
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.1	10.5	0.9	3.7		18.2		19.4
QSRatio									
95th Percentile Output:									
fB%		2.5	1.9	2.5	2.3		1.7		1.7
BOQ		1.4	12.0	1.1	4.6		19.9		21.2
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.8		1.8
BOQ		1.8	13.6	1.4	5.5		21.7		22.9
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	177	182		143	202		185		135			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	920	1839	0.38	0.50	15.0	B	15.0	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	571	1141	0.66	0.50	22.8	C	22.8	C
----	-----	------	------	------	------	---	------	---

Northbound

LR	562	1444	0.65	0.39	27.7	C	27.7	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 21.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		177	182	143	202		185		135			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		49	51	39	55		53		38			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		350			379			363				
%InSharedLn												
Prop LTs		0.000			0.414			0.579				
Prop RTs		0.437			0.000			0.421				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		177	182	143	202		185		135			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		197	153	157	222		210		153			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		350			379			363				
Prop LTs		0.000			0.414			0.579				
Prop RTs		0.437			0.000			0.421				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.941			1.000			0.943					
fLT	1.000			0.615			0.972					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1839			1141			1444					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	350	1839	0.19	0.50	920	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	379	1141	# 0.33	0.50	571	0.66
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	363	1444	# 0.25	0.39	562	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.38	0.50	13.9	1.000	920	0.50	1.1	0.0	15.0	B	15.0	B
Westbound												
LT	0.66	0.50	16.8	1.000	571	0.50	5.9	0.0	22.8	C	22.8	C
Northbound												
LR	0.65	0.39	22.4	1.000	562	0.50	5.2	0.0	27.7	C	27.7	C
Southbound												

Intersection delay = 21.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	157		
Proportion of LT in LT lane group, PLT	0.000	0.414	0.579
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	350		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.93		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.75		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.9		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	7.37		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	37.63		
n=Max(gq-gf)/2,0)	3.24		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.41		
EL1 (refer to Exhibit C16-3)	1.98		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.61		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.615		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	16.8	0.00	0.0	0.0	22.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	22.4	0.00	0.0	0.0	27.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			21.9	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		350			379			363				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1839			1141			1444				
LnCapacity		920			571			562				
Flow Ratio		0.2			0.3			0.3				
v/c Ratio		0.38			0.66			0.65				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.4			7.1			7.4				
kB		1.0			0.8			0.7				
Q2		0.6			1.4			1.2				
Q Average		6.0			8.5			8.6				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		7.4			10.4			10.5				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.5			1.5				
BOQ		9.0			12.4			12.5				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.6			1.6				
BOQ		10.0			13.5			13.7				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.8			1.8				
BOQ		11.5			15.2			15.3				
QSRatio												
98th Percentile Output:												
fB%		2.1			2.0			2.0				
BOQ		13.0			16.8			17.0				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	33	18	28	55	17	33	28	234	66	56	234	27
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 230 1968 0.40 0.12 29.7 C 29.7 C

Westbound

LTR 497 1989 0.26 0.25 19.3 B 19.3 B

Northbound

LTR 711 1854 0.53 0.38 17.1 B 17.1 B

Southbound

LTR 655 1710 0.60 0.38 18.8 B 18.8 B

Intersection Delay = 19.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	33	18	28	55	17	33	28	234	66	56	234	27
% Heavy Veh	2	2	2	1	1	1	6	6	6	9	9	9
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
PK 15 Vol	10	5	8	17	5	10	8	67	19	17	72	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		92			130			377			391	
%InSharedLn												
Prop LTs		0.413			0.523			0.085			0.176	
Prop RTs		0.359			0.315			0.202			0.084	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	33	18	28	55	17	33	28	234	66	56	234	27
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
Adj flow	38	21	33	68	21	41	32	269	76	69	289	33
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	92			130			377			391		
Prop LTs	0.413			0.523			0.085			0.176		
Prop RTs	0.359			0.315			0.202			0.084		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.980			0.990			0.943			0.917		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.952			0.957			0.973			0.989		
fLT	0.980			0.975			0.946			0.883		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1968			1989			1854			1710		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	92	1968	# 0.05	0.12	230	0.40
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	130	1989	# 0.07	0.25	497	0.26
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	377	1854	0.20	0.38	711	0.53
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	391	1710	# 0.23	0.38	655	0.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.40	0.12	24.6	1.000	230	0.50	5.1	0.0	29.7	C	29.7	C	
Westbound													
LTR	0.26	0.25	18.1	1.000	497	0.50	1.3	0.0	19.3	B	19.3	B	
Northbound													
LTR	0.53	0.38	14.3	1.000	711	0.50	2.8	0.0	17.1	B	17.1	B	
Southbound													
LTR	0.60	0.38	14.8	1.000	655	0.50	4.0	0.0	18.8	B	18.8	B	

Intersection delay = 19.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			32	69
Proportion of LT in LT lane group, PLT	0.413	0.523	0.085	0.176
Proportion of LT in opposing flow, PLTo			0.18	0.08
Adjusted opposing flow rate, Vo (veh/h)			391	377
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.53	1.15
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.52	6.28
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.9	4.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			7.35	7.01
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.11	15.99
n=Max(gq-gf)/2,0)			0.00	1.51
PTHo=1-PLTo			0.82	0.92
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.08	0.18
EL1 (refer to Exhibit C16-3)			2.06	2.03
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.47
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			0.00	3.01
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.95	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.946	0.883

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.01
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.305
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				377
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.176
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.359	0.202
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	29.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.1	0.00	0.0	0.0	19.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.3	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.8	0.00	0.0	0.0	18.8
	0.0						0.0	
Intersection Delay			19.2	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	92		130		377		391	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0	0 1 0	0	0 1 0	0	0 1 0	
SL	1968		1989		1854		1710	
LnCapacity	230		497		711		655	
Flow Ratio	0.0		0.1		0.2		0.2	
v/c Ratio	0.40		0.26		0.53		0.60	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.4		1.7		4.9		5.2	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.2		0.8		0.9	
Q Average	1.6		1.9		5.6		6.1	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.1		2.4		6.9		7.5	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.6		3.1		8.4		9.1	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.8		1.7		1.6	
BOQ	3.0		3.5		9.3		10.1	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.3		1.9		1.9	
BOQ	3.8		4.4		10.8		11.6	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.7		2.2		2.1	
BOQ	4.5		5.2		12.3		13.1	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		303	18			14	305	
Peak-Hour Factor, PHF		0.87	0.87			0.81	0.81	
Hourly Flow Rate, HFR		348	20			17	376	
Percent Heavy Vehicles		--	--			7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		28		26				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		41		38				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			17			79					
C(m) (vph)			1163			462					
v/c			0.01			0.17					
95% queue length			0.04			0.61					
Control Delay			8.1			14.4					
LOS			A			B					
Approach Delay						14.4					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		303	18	14	305	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		87	5	4	94	
Hourly Flow Rate, HFR		348	20	17	376	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	28		26			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	10		10			
Hourly Flow Rate, HFR	41		38			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		376
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		368	768		358			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	358	
Potential Capacity	675	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	675	
Probability of Queue free St.	0.94	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	368	
Potential Capacity	1163	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1163	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	768	
Potential Capacity	363	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.93
Movement Capacity	358	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 768
Potential Capacity 363
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.93
Movement Capacity 358

Results for Two-stage process:
a
y
C t 358

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	41		38			
Movement Capacity (vph)	358		675			
Shared Lane Capacity (vph)		462				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	358		675			
Volume	41		38			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		462				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		17		79				
C(m) (vph)		1163		462				
v/c		0.01		0.17				
95% queue length		0.04		0.61				
Control Delay		8.1		14.4				
LOS		A		B				
Approach Delay				14.4				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		376
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.1
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	10	2	333	20	268	4	136	315	210	236	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	723	1735	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	530	1273	0.81	0.42	27.4	C	23.8	C
R	523	1256	0.63	0.42	19.0	B		

Northbound

LTR	740	1776	0.66	0.42	18.3	B	18.3	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	451	1082	1.15	0.42	108.1	F	108.1	F
-----	-----	------	------	------	-------	---	-------	---

Intersection Delay = 46.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	10	2	333	20	268	4	136	315	210	236	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	102	6	82	1	37	85	61	69	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		14			430	327		489			519	
%InSharedLn												
Prop LTs		0.071			0.944			0.008			0.470	
Prop RTs		0.143			0.000	1.000		0.693			0.002	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	10	2	333	20	268	4	136	315	210	236	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	11	2	406	24	327	4	146	339	244	274	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	14			430 327			489			519		
Prop LTs	0.071			0.944			0.008			0.470		
Prop RTs	0.143			0.000 1.000			0.693			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.981			1.000 0.850			0.906			1.000		
fLT	0.981			0.728			0.996			0.542		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1735			1273 1256			1776			1082		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	14	1735	0.01	0.42	723	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	430	1273	# 0.34	0.42	530	0.81
Right	R	327	1256	0.26	0.42	523	0.63
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	489	1776	0.28	0.42	740	0.66
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	519	1082	# 0.48	0.42	451	1.15
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.82
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	723	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.81	0.42	15.4	1.000	530	0.50	11.9	0.0	27.4	C	23.8	C
R	0.63	0.42	13.8	1.000	523	0.50	5.2	0.0	19.0	B		
Northbound												
LTR	0.66	0.42	14.1	1.000	740	0.50	4.2	0.0	18.3	B	18.3	B
Southbound												
LTR	1.15	0.42	17.5	1.000	451	0.50	90.6	0.0	108.1	F	108.1	F

Intersection delay = 46.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	406	4	244
Proportion of LT in LT lane group, PLT	0.071	0.944	0.008	0.470
Proportion of LT in opposing flow, PLTo	0.94	0.07	0.47	0.01
Adjusted opposing flow rate, Vo (veh/h)	430	14	519	489
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	6.77	0.07	4.07
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.17	0.23	8.65	8.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	7.51	0.00	9.44	8.80
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	16.20
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.40
PTHo=1-PLTo	0.06	0.93	0.53	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07	0.94	0.01	0.47
EL1 (refer to Exhibit C16-3)	2.14	1.40	2.34	2.27
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.34
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	8.80
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.981	0.728	0.996	0.542

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	7.51		9.44	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.301		0.378	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	430		519	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.071		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.4	0.00	0.0	0.0	27.4
R	0.0	0.00	17.5	13.8	0.00	0.0	0.0	19.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.1	0.00	0.0	0.0	18.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	17.0	0.0	108.1
	0.0						0.0	
Intersection Delay			46.8	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	14			430	327	489			519			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1735			1273	1256	1776			1082			
LnCapacity	723			530	523	740			451			
Flow Ratio	0.0			0.3	0.3	0.3			0.5			
v/c Ratio	0.02			0.81	0.63	0.66			1.15			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.933		0.919			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			6.3	4.3	6.6			8.6			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			1.9	0.8	1.2			11.3			
Q Average	0.2			8.2	5.1	7.8			20.0			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			10.0	6.3	9.5			24.0			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.4			
BOQ	0.3			12.0	7.7	11.4			28.1			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.7	1.6			1.5			
BOQ	0.3			13.1	8.6	12.5			30.1			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.8	2.0	1.8			1.6			
BOQ	0.4			14.8	10.0	14.1			32.3			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.0	2.2	2.0			1.7			
BOQ	0.5			16.4	11.5	15.7			34.5			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				449		4		451			571	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas
 Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.81 0.33 22.2 C 22.2 C

Northbound

T 1026 2051 0.47 0.50 11.3 B 11.3 B

Southbound

T 954 1907 0.70 0.50 13.0 B 13.0 B

Intersection Delay = 15.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				449		4	451			571		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				134		1	121			166		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					540		485			664		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				449		4	451			571		
PHF				0.84		0.84	0.93			0.86		
Adj flow				535		5	485			664		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					540			485			664	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	540	2009	# 0.27	0.33	670	0.81
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	485	2051	0.24	0.50	1026	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	664	1907	# 0.35	0.50	954	0.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.81	0.33	18.2	1.000	670	0.50	4.0	0.0	22.2	C	22.2	C	
Northbound													
T	0.47	0.50	9.8	1.000	1026	0.50	1.4	0.0	11.3	B	11.3	B	
Southbound													
T	0.70	0.50	11.5	1.000	954	0.50	1.5	0.0	13.0	B	13.0	B	

Intersection delay = 15.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.2	0.00	0.0	0.0	22.2
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	9.8	0.00	0.0	0.0	11.3
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.5	0.00	0.0	0.0	13.0
	0.0						0.0	
Intersection Delay			15.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3		4	5	6
		L	T	R		L	T	R
Volume		451	254			182	838	
Peak-Hour Factor, PHF		0.93	0.93			0.86	0.86	
Hourly Flow Rate, HFR		484	273			211	974	
Percent Heavy Vehicles		--	--			18	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9		10	11	12
		L	T	R		L	T	R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		211						
C(m) (vph)		786						
v/c		0.27						
95% queue length		1.08						
Control Delay		11.3						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		451	254	182	838	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		121	68	53	244	
Hourly Flow Rate, HFR		484	273	211	974	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		974
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		757						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	757	
Potential Capacity	786	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	786	
Probability of Queue free St.	0.73	1.00
Maj L-Shared Prob Q free St.	0.37	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.37	0.37
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.73	0.73
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		211						
C(m) (vph)		786						
v/c		0.27						
95% queue length		1.08						
Control Delay		11.3						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.73
v(i1), Volume for stream 2 or 5		974
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.37
d(M,LT), Delay for stream 1 or 4		11.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		7.1

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				130		149	543		101	124	698	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 398 1493 0.83 0.27 37.5 D 37.5 D

Northbound

TR 1096 1935 0.63 0.57 11.0 B 11.0 B

Southbound

LT 751 1326 1.27 0.57 137.1 F 137.1 F

Intersection Delay = 76.3 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				130		149	543	101		124	698	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				39		44	146	27		36	203	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					332			693			956	
%InSharedLn												
Prop LTs					0.467			0.000			0.151	
Prop RTs					0.533			0.157			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				130		149	543	101		124	698	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				155		177	584	109		144	812	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					332			693			956	
Prop LTs					0.467			0.000			0.151	
Prop RTs					0.533			0.157			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.928			0.979			1.000	
fLT					0.977			1.000			0.678	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1493			1935			1326	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	332	1493	# 0.22	0.27	398	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	693	1935	0.36	0.57	1096	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	956	1326	# 0.72	0.57	751	1.27
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.94
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.13

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.83	0.27	20.7	1.000	398	0.50	16.7	0.0	37.5	D	37.5	D
Northbound												
TR	0.63	0.57	8.8	1.000	1096	0.50	2.2	0.0	11.0	B	11.0	B
Southbound												
LT	1.27	0.57	13.0	1.000	751	0.50	124.1	0.0	137.1	F	137.1	F

Intersection delay = 76.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			144
Proportion of LT in LT lane group, PLT	0.467	0.000	0.151
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			693
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			2.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.13
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.87
n=Max(gq-gf)/2,0)			2.74
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.15
EL1 (refer to Exhibit C16-3)			2.78
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.678

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.13
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.239
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				693
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.151
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.533	0.157
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.7	0.00	0.0	0.0	37.5
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.8	0.00	0.0	0.0	11.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	51.3	0.0	137.1
	0.0						0.0	
Intersection Delay			76.3	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	94	44	109	33	188	51	64	564	104	116	537	49
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	460	1335	0.61	0.34	27.5	C	27.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	567	1647	0.59	0.34	28.8	C	28.8	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	285	524	0.25	0.54	12.4	B		
TR	1067	1960	0.69	0.54	17.7	B	17.3	B

Southbound

LTR	981	1802	0.81	0.54	23.7	C	23.7	C
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Intersection Delay = 22.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	94	44	109	33	188	51	64	564	104	116	537	49
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
PK 15 Vol	27	13	31	10	58	16	18	155	29	33	154	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		281			336		70	734			795	
%InSharedLn												
Prop LTs		0.381			0.122		1.000	0.000			0.167	
Prop RTs		0.441			0.188			0.155			0.057	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	94	44	109	33	188	51	64	564	104	116	537	49
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.91	0.91	0.87	0.87	0.87
Adj flow	107	50	124	41	232	63	70	620	114	133	617	45
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	281			336			70 734			795		
Prop LTs	0.381			0.122			1.000 0.000			0.167		
Prop RTs	0.441			0.188			0.155			0.057		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.940			0.975			0.977			0.992		
fLT	0.666			0.933			0.299 1.000			0.575		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1335			1647			524 1960			1802		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	281	1335	# 0.21	0.34	460	0.61
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	336	1647	0.20	0.34	567	0.59
Right							
Northbound							
Prot							
Perm							
Left	L	70	524	0.13	0.54	285	0.25
Prot							
Perm							
Thru	TR	734	1960	0.37	0.54	1067	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	795	1802	# 0.44	0.54	981	0.81
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.61	0.34	24.5	1.000	460	0.50	3.0	0.0	27.5	C	27.5	C	
Westbound													
LTR	0.59	0.34	24.3	1.000	567	0.50	4.5	0.0	28.8	C	28.8	C	
Northbound													
L	0.25	0.54	10.8	1.000	285	0.50	1.6	0.0	12.4	B			
TR	0.69	0.54	14.9	1.000	1067	0.50	2.8	0.0	17.7	B	17.3	B	
Southbound													
LTR	0.81	0.54	16.7	1.000	981	0.50	6.9	0.0	23.7	C	23.7	C	

Intersection delay = 22.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			70	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.17	
Adjusted opposing flow rate, Vo (veh/h)			795	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.75	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.44	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			7.38	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			41.62	
n=Max(gq-gf)/2,0)			3.69	
PTHo=1-PLTo			0.83	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.84	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.94	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			7.38	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.30	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.299	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	107	41	133
Proportion of LT in LT lane group, PLT	0.381	0.122	0.000
Proportion of LT in opposing flow, PLTo	0.12	0.38	0.00
Adjusted opposing flow rate, Vo (veh/h)	336	281	734
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.67	1.02	3.33
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.40	7.03	18.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.3	7.9	1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	10.99	8.95	23.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.01	22.05	25.77
n=Max(gq-gf)/2,0)	4.85	0.50	11.08
PTHo=1-PLTo	0.88	0.62	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.38	0.12	0.74
EL1 (refer to Exhibit C16-3)	1.95	1.85	2.89
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.84	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.07
gdifff=max(gq-gf,0)	9.71	1.01	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67	0.93	0.24
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.666	0.933	0.575

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	10.99	8.95	7.38	23.23
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.354	0.289	0.151	0.474
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	336	281	795	734
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.381	0.122	1.000	0.167
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.441	0.188	0.155	0.057
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.5	0.00	0.0	0.0 0.0 0.0	27.5
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	24.3	0.00	0.0	0.0 0.0 0.0	28.8
Northbound								
L	0.0	0.00	20.5	10.8	0.00	0.0	0.0	12.4
TR	0.0 0.0	0.00	20.5	14.9	0.00	0.0	0.0 0.0	17.7
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	16.7	0.00	0.0	0.0 0.0 0.0	23.7
Intersection Delay			22.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	281		336		70	734	417	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 0	1 0	0	1 1 0	0 0	2 0	
SL	1335		1647		524	1960	946	
LnCapacity	460		567		285	1067	515	
Flow Ratio	0.2		0.2		0.1	0.4	0.4	
v/c Ratio	0.61		0.59		0.25	0.69	0.81	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	5.8		6.9		0.9	13.4	8.5	
kB	0.3		0.8		0.4	0.9	0.7	
Q2	0.5		1.1		0.1	1.9	2.4	
Q Average	6.3		8.0		1.0	15.3	10.9	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	7.8		9.8		1.3	18.4	13.2	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.4	
BOQ	9.4		11.7		1.7	21.6	15.7	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.6	
BOQ	10.4		12.8		2.0	23.3	17.0	
QSRatio								
95th Percentile Output:								
fB%	1.9		1.8		2.4	1.6	1.7	
BOQ	11.9		14.4		2.5	25.2	18.7	
QSRatio								
98th Percentile Output:								
fB%	2.1		2.0		2.9	1.8	1.9	
BOQ	13.5		16.0		3.0	27.1	20.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	368						710			633		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	675	2025	0.60	0.33	28.9	C	28.9	C

Westbound

Northbound

T 2156 3880 0.37 0.56 11.5 B 11.5 B

Southbound

T 1990 3582 0.37 0.56 11.7 B 11.7 B

Intersection Delay = 15.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	368						710			633		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	101						197			182		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	404						789			728		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	368						710			633		
PHF	0.91						0.90			0.87		
Adj flow	404						789			728		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	404						789			728		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.990							0.990				0.990			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2025							3880				3582			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	404	2025	# 0.20	0.33	675	0.60
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	789	3880	# 0.20	0.56	2156	0.37
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	728	3582	0.20	0.56	1990	0.37
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.40$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.45$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.60	0.33	25.0	1.000	675	0.50	3.9	0.0	28.9	C	28.9	C	
Westbound													
Northbound													
T	0.37	0.56	11.2	1.000	2156	0.50	0.4	0.0	11.5	B	11.5	B	
Southbound													
T	0.37	0.56	11.2	1.000	1990	0.50	0.5	0.0	11.7	B	11.7	B	

Intersection delay = 15.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	25.0	0.00	0.0	0.0	28.9
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.2	0.00	0.0	0.0	11.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.2	0.00	0.0	0.0	11.7
	0.0						0.0	
Intersection Delay			15.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	404						414		382	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.60						0.37		0.37	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.4						5.8		5.3	
kB	0.9						1.0		1.1	
Q2	1.2						0.6		0.6	
Q Average	9.7						6.3		6.0	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	11.7						7.8		7.3	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	13.9						9.4		8.9	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	15.2						10.4		9.9	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.9		1.9	
BOQ	16.9						11.9		11.4	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.2	
BOQ	18.5						13.4		12.9	
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: S Bridge St RT & Page Ave
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: South Bridge Street Right Turn
North/South Street: Page Avenue
Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound			Southbound		
		1	2	3	4	5	6
		L	T	R	L	T	R

Volume						633
Peak-Hour Factor, PHF						0.87
Hourly Flow Rate, HFR						727
Percent Heavy Vehicles	--	--				-- --
Median Type/Storage	Raised	curb		/ 1		
RT Channelized?						
Lanes						2
Configuration						T
Upstream Signal?	No					No

Minor Street:	Approach Movement	Westbound			Eastbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	69
Peak Hour Factor, PHF	0.78
Hourly Flow Rate, HFR	88
Percent Heavy Vehicles	55
Percent Grade (%)	0
Flared Approach: Exists?/Storage	/
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config								R

v (vph)		88
C(m) (vph)		577
v/c		0.15
95% queue length		0.54
Control Delay		12.4
LOS		B
Approach Delay	12.4	
Approach LOS	B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					633	
Peak-Hour Factor, PHF					0.87	
Peak-15 Minute Volume					182	
Hourly Flow Rate, HFR					727	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						69
Peak Hour Factor, PHF						0.78
Peak-15 Minute Volume						22
Hourly Flow Rate, HFR						88
Percent Heavy Vehicles						55
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								364
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		364
Potential Capacity		577
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		577
Probability of Queue free St.	1.00	0.85
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	432
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	432
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	432	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	432	900

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	482
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	482

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.85	1.00
Movement Capacity		

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						577
Volume						88
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								88
C(m) (vph)								577
v/c								0.15
95% queue length								0.54
Control Delay								12.4
LOS								B
Approach Delay							12.4	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2015 With-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	158	247	195	239	486	44	107	177	141	46	61	104
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	180	540	1.00	0.33	86.2	F		
TR	592	1775	0.76	0.33	33.2	C	48.3	D
Westbound								
L	240	696	1.11	0.34	118.2	F		
TR	1154	3349	0.55	0.34	25.6	C	53.0	D
Northbound								
LTR	936	3370	0.46	0.28	28.5	C	28.5	C
Southbound								
L	384	1728	0.16	0.22	29.1	C		
TR	357	1607	0.52	0.22	35.8	D	34.1	C

Intersection Delay = 44.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	158	247	195	239	486	44	107	177	141	46	61	104
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	45	70	55	66	148	13	29	48	38	15	20	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	180	451		266	633			430		61	184	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.267			0.000	
Prop RTs		0.377			0.063			0.291			0.565	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	158	247	195	239	486	44	107	177	141	46	61	104
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	180	281	170	266	593	40	115	190	125	61	80	104
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	180	451		266	633		430			61	184	
Prop LTs	1.000	0.000		1.000	0.000		0.267			0.000		
Prop RTs	0.377			0.063			0.291			0.565		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.943			0.991		0.956				0.915	
fLT	0.297	1.000		0.409*	1.000		0.987			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	540	1775		696	3349		3370			1728	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	180	540	0.33	0.33	180	1.00
Prot							
Perm							
Thru	TR	451	1775	0.25	0.33	592	0.76
Right							
Westbound							
Prot							
Perm							
Left	L	266	696	# 0.38	0.34	240	1.11
Prot							
Perm							
Thru	TR	633	3349	0.19	0.34	1154	0.55
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	430	3370	# 0.13	0.28	936	0.46
Right							
Southbound							
Prot							
Perm							
Left	L	61	1728	0.04	0.22	384	0.16
Prot							
Perm							
Thru	TR	184	1607	# 0.11	0.22	357	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.00	0.33	30.0	1.000	180	0.50	56.2	0.0	86.2	F		
TR	0.76	0.33	26.8	1.000	592	0.50	6.4	0.0	33.2	C	48.3	D
Westbound												
L	1.11	0.34	29.5	1.000	240	0.50	88.7	0.0	118.2	F		
TR	0.55	0.34	23.8	1.000	1154	0.50	1.8	0.0	25.6	C	53.0	D
Northbound												
LTR	0.46	0.28	26.9	1.000	936	0.50	1.6	0.0	28.5	C	28.5	C
Southbound												
L	0.16	0.22	28.2	1.000	384	0.50	0.9	0.0	29.1	C		
TR	0.52	0.22	30.7	1.000	357	0.50	5.1	0.0	35.8	D	34.1	C

Intersection delay = 44.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	180	266		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	633	451		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.50	6.65		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.31	11.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	8.37	16.06		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.63	14.94		
n=Max(gq-gf)/2,0)	4.18	8.03		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.43	1.99		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30	0.24		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.297	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.267 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	8.37			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.279			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	633			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.063
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	0.0	0.0	86.2
TR	0.0	0.00	30.0	26.8	0.00	0.0	0.0	33.2
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	6.5	0.0	118.2
TR	0.0	0.00	29.5	23.8	0.00	0.0	0.0	25.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	26.9	0.00	0.0	0.0	28.5
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	29.1
TR	0.0	0.00	35.0	30.7	0.00	0.0	0.0	35.8
	0.0						0.0	

Intersection Delay	44.8	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	180	451		266	332		225			61	184	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	540	1775		696	1758		1769			1728	1607	
LnCapacity	180	592		240	606		491			384	357	
Flow Ratio	0.3	0.3		0.4	0.2		0.1			0.0	0.1	
v/c Ratio	1.00	0.76		1.11	0.55		0.46			0.16	0.52	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.5	10.1		6.7	6.7		4.7			1.2	4.0	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	2.3	1.6		5.6	0.9		0.6			0.1	0.6	
Q Average	6.8	11.7		12.3	7.6		5.2			1.3	4.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	8.4	14.2		14.8	9.3		6.5			1.7	5.7	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.5		1.5			1.6	1.5	
BOQ	10.1	16.7		17.5	11.1		7.9			2.2	7.0	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.5	1.6		1.7			1.9	1.7	
BOQ	11.1	18.1		18.9	12.2		8.8			2.5	7.8	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.7		1.7	1.8		2.0			2.4	2.0	
BOQ	12.7	19.8		20.7	13.8		10.2			3.2	9.2	
QSRatio												
98th Percentile Output:												
fB%	2.1	1.8		1.8	2.0		2.2			2.8	2.3	
BOQ	14.2	21.6		22.4	15.4		11.7			3.8	10.6	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								495	
Peak-Hour Factor, PHF								0.89	
Hourly Flow Rate, HFR								556	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided				/			
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		396							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		425							
Percent Heavy Vehicles		3							
Percent Grade (%)			0					0	
Flared Approach: Exists?/Storage						/			
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			425							
C(m) (vph)			490							
v/c			0.87							
95% queue length			9.20							
Control Delay			43.8							
LOS			E							
Approach Delay				43.8						
Approach LOS				E						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 495
 Peak-Hour Factor, PHF 0.89
 Peak-15 Minute Volume 139
 Hourly Flow Rate, HFR 556
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 396
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 106
 Hourly Flow Rate, HFR 425
 Percent Heavy Vehicles 3
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
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Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			556					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	556	
Potential Capacity	490	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	490	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 556
Potential Capacity 490
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 490

Results for Two-stage process:
a
y
C t 490

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	425					
Movement Capacity (vph)	490					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	490					
Volume	425					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			425					
C(m) (vph)			490					
v/c			0.87					
95% queue length			9.20					
Control Delay			43.8					
LOS			E					
Approach Delay				43.8				
Approach LOS				E				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	14	111	54	143	150	165	15	39	67	80	193	60
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.87	0.87	0.91	0.91	0.76	1.00	1.00	1.00
Flow Rate	79	126	239	263	70	67	176	157
% Heavy Veh	7	7	1	1	1	0	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	79	126	239	263	70	67	176	157
Left-Turn	16	0	157	0	19	0	80	0
Right-Turn	0	62	0	181	0	67	0	60
Prop. Left-Turns	0.2	0.0	0.7	0.0	0.3	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.5	0.0	0.7	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.2	-0.2	0.3	-0.5	0.2	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	79	126	239	263	70	67	176	157
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.07	0.11	0.21	0.23	0.06	0.06	0.16	0.14
hd, final value	6.81	6.36	6.54	5.73	7.05	6.20	6.80	6.30
x, final value	0.15	0.22	0.43	0.42	0.14	0.12	0.33	0.27
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	4.5	4.1	4.2	3.4	4.8	3.9	4.5	4.0

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	79	126	239	263	70	67	176	157
Service Time	4.5	4.1	4.2	3.4	4.8	3.9	4.5	4.0
Utilization, x	0.15	0.22	0.43	0.42	0.14	0.12	0.33	0.27
Dep. headway, hd	6.81	6.36	6.54	5.73	7.05	6.20	6.80	6.30
Capacity	329	376	489	513	320	317	426	407
Delay	10.70	10.88	14.16	12.49	10.87	9.71	12.84	11.38
LOS	B	B	B	B	B	A	B	B
Approach:								
Delay	10.81		13.28		10.30		12.15	
LOS	B		B		B		B	
Intersection Delay	12.19		Intersection		LOS B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	51	131	227	232	437	9	219	142	121	21	523	120
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	826	3231	0.56	0.26	31.6	C	31.6	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	889	3480	0.93	0.26	49.1	D	49.1	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	151	468	1.56	0.32	310.6	F		
TR	583	1810	0.49	0.32	27.4	C	155.9	F

Southbound

LTR	956	2968	0.74	0.32	32.2	C	32.2	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 63.1 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	51	131	227	232	437	9	219	142	121	21	523	120
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	14	37	64	71	133	3	59	38	33	6	139	32
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		465			827		235	283			706	
%InSharedLn												
Prop LTs		0.125			0.342		1.000	0.000			0.031	
Prop RTs		0.555			0.013			0.459			0.181	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	51	131	227	232	437	9	219	142	121	21	523	120
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	58	149	258	283	533	11	235	153	130	22	556	128
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	465			827			235 283			706		
Prop LTs	0.125			0.342			1.000 0.000			0.031		
Prop RTs	0.555			0.013			0.459			0.181		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.917			0.998			0.931			0.973		
fLT	0.994			0.983			0.240 1.000			0.939		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3231			3480			468 1810			2968		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	465	3231	# 0.14	0.26	826	0.56
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	827	3480	# 0.24	0.26	889	0.93
Right							
Northbound							
Prot							
Perm							
Left	DefL	235	468	# 0.50	0.32	151	1.56
Prot							
Perm							
Thru	TR	283	1810	0.16	0.32	583	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	706	2968	0.24	0.32	956	0.74
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.88
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.56	0.26	29.1	1.000	826	0.50	2.5	0.0	31.6	C	31.6	C	
Westbound													
LTR	0.93	0.26	32.7	1.000	889	0.50	16.4	0.0	49.1	D	49.1	D	
Northbound													
DefL	1.56	0.32	30.5	1.000	151	0.50	280.1	0.0	310.6	F			
TR	0.49	0.32	24.5	1.000	583	0.50	2.9	0.0	27.4	C	155.9	F	
Southbound													
LTR	0.74	0.32	27.1	1.000	956	0.50	5.1	0.0	32.2	C	32.2	C	

Intersection delay = 63.1 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			235	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			706	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			5.88	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.27	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			10.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			18.17	
n=Max(gq-gf)/2,0)			5.41	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.61	
EL2=Max((1-Ptho*n)/Plto, 1.0)			5.05	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			10.83	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.240	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	22
Proportion of LT in LT lane group, PLT	0.125 0.342 0.000 0.031
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	283
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.55
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.54
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	11.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.20
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.67
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07
EL1 (refer to Exhibit C16-3)	1.85
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.939

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.20
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.007
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				283
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.031
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.555	0.013	0.459
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	29.1	0.00	0.0	0.0 0.0 0.0	31.6
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	32.7	0.00	0.0	0.0 0.0 0.0	49.1
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	21.0	0.0	310.6
TR	0.0 0.0	0.00	30.5	24.5	0.00	0.0	0.0 0.0	27.4
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	27.1	0.00	0.0	0.0 0.0 0.0	32.2
Intersection Delay			63.1	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	244		434		235	283	370	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0
SL	1696		1827		468	1810	1558	
LnCapacity	433		466		151	583	502	
Flow Ratio	0.1		0.2		0.5	0.2	0.2	
v/c Ratio	0.56		0.93		1.56	0.49	0.74	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	5.3		10.6		5.9	5.7	8.2	
kB	0.6		0.6		0.3	0.8	0.7	
Q2	0.7		4.1		11.3	0.7	1.8	
Q Average	6.0		14.7		17.2	6.4	10.0	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	7.4		17.8		20.7	7.9	12.1	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.4	1.5	1.4	
BOQ	9.0		20.9		24.2	9.5	14.4	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.5		1.5	1.6	1.6	
BOQ	9.9		22.5		26.0	10.5	15.7	
QSRatio								
95th Percentile Output:								
fB%	1.9		1.7		1.6	1.9	1.7	
BOQ	11.4		24.4		28.0	12.0	17.4	
QSRatio								
98th Percentile Output:								
fB%	2.2		1.8		1.7	2.1	1.9	
BOQ	12.9		26.2		30.0	13.6	19.0	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	723	349	4	3	356	625	2	3	2	124	0	275
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	813	1728	0.99	0.73	40.8	D		
TR	1206	1644	0.33	0.73	4.7	A	29.0	C
Westbound								
LT	584	1876	0.65	0.31	30.3	C	129.1	F
R	497	1599	1.32	0.31	185.8	F		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.71	0.16	54.6	D		
LT	283	1818	0.00	0.16	32.1	C	24.4	C
R	862	1492	0.40	0.58	11.8	B		

Intersection Delay = 66.1 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	723	349	4	3	356	625	2	3	2	124	0	275
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.86	0.80	0.80
PK 15 Vol	201	97	1	1	94	164	1	2	1	36	0	86
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	803	392			378	658		17		144	0	344
%InSharedLn										0		
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.010			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.687			0.650			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		33.0	28.0					14.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	723	349	4	3	356	625	2	3	2	124	0	275
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.86	0.80	0.80
Adj flow	803	388	4	3	375	658	5	7	5	144	0	344
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	803	392			378	658		17		144	0	344
Prop LTs	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTs		0.010			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.998		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.269											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1644		1876	1599		952			1310	1818	1492
Sec.	489											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		634	1728	# 0.37	0.367	634	1.00
Perm		169	489	0.35	0.367	179	0.94
Left	L	803			0.73	813	0.99
Prot							
Perm							
Thru	TR	392	1644	0.24	0.73	1206	0.33
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	378	1876	0.20	0.31	584	0.65
Right	R	658	1599	# 0.41	0.31	497	1.32
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	144	1310	# 0.11	0.16	204	0.71
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	344	1492	0.23	0.58	862	0.40

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.89$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.07$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.99	0.73	17.4	1.000	813	0.50	23.4	0.0	40.8	D		
TR	0.33	0.73	4.2	1.000	1206	0.50	0.5	0.0	4.7	A	29.0	C
Westbound												
LT	0.65	0.31	26.7	1.000	584	0.50	3.6	0.0	30.3	C	129.1	F
R	1.32	0.31	31.0	1.000	497	0.50	154.8	0.0	185.8	F		
Northbound												
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C
Southbound												
L	0.71	0.16	36.0	1.000	204	0.50	18.6	0.0	54.6	D		
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	24.4	C

R 0.40 0.58 10.4 1.000 862 0.50 1.4 0.0 11.8 B

Intersection delay = 66.1 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	803			144
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	378			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.08			3.60
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.45			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	16.48			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.52			14.00
n=Max(gq-gf)/2,0)	8.24			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.86			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	8.01			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	16.48			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.27			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.269			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.008	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	392	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.80	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.06	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		392		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.008		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	66.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	66.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.010
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	803			
v/c ratio from Capacity Worksheet, X	0.99			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	16.48			
Unopposed green interval, gu	16.52			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.27			
XPerm	1.64			
XProt	0.80			
Case	3			
Queue at beginning of green arrow, Qa	8.23			
Queue at beginning of unsaturated green, Qu	3.68			
Residual queue, Qr	2.88			
Uniform Delay, d1	17.4			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		17.4	0.00	0.0	0.0	40.8
TR	0.0	0.00	12.0	4.2	0.00	0.0	0.0	4.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	26.7	0.00	0.0	0.0	30.3
R	0.0	0.00	31.0	31.0	0.00	40.2	0.0	185.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	36.0	0.00	0.0	0.0	54.6
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.4	0.00	0.0	0.0	11.8
Intersection Delay			66.1	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	803	392		378	658		17	144	0	344
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1108	1644		1876	1599		952	1310	1818	1492
LnCapacity	813	1206		584	497		148	204	283	862
Flow Ratio	0.7	0.2		0.2	0.4		0.0	0.1	0.0	0.2
v/c Ratio	0.99	0.33		0.65	1.32		0.11	0.71	0.00	0.40
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.4	3.4		8.2	16.5		0.4	3.4	0.0	4.7
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	7.7	0.4		0.9	21.8		0.0	0.8	0.0	0.7
Q Average	16.0	3.9		9.1	38.3		0.4	4.2	0.0	5.4
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.2	1.3	1.2
BOQ	19.3	4.8		11.0	45.9		0.5	5.3	0.0	6.7
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4		1.7	1.5	1.7	1.5
BOQ	22.7	5.9		13.1	53.6		0.7	6.5	0.0	8.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6	1.5		2.0	1.7	2.0	1.7
BOQ	24.4	6.7		14.3	57.4		0.8	7.2	0.0	9.0
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8	1.6		2.5	2.0	2.6	1.9
BOQ	26.3	8.0		16.0	61.3		1.0	8.6	0.0	10.5
QSRatio										
98th Percentile Output:										
fB%	1.8	2.4		1.9	1.7		3.1	2.3	3.2	2.2
BOQ	28.2	9.2		17.6	65.1		1.2	9.9	0.0	11.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2015 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	442	35	0	1	35	42	3	3	2	60	1	946
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	755	1509	0.65	0.50	20.8	C		
TR	1066	2132	0.04	0.50	11.5	B	20.1	C

LTR	1561	3122	0.05	0.50	11.6	B	11.6	B
-----	------	------	------	------	------	---	------	---

LTR	1220	3137	0.01	0.39	16.9	B	16.9	B
-----	------	------	------	------	------	---	------	---

LT	550	1414	0.12	0.39	18.0	B	95.6	F
R	616	1583	1.13	0.39	102.9	F		

Intersection Delay = 61.2 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	442	35	0	1	35	42	3	3	2	60	1	946
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	123	10	0	1	9	11	2	2	1	16	1	252
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	491	39			72			16			65	694
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	442	35	0	1	35	42	3	3	2	60	1	946
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	491	39	0	1	37	34	6	6	4	64	1	694
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	491	39			72			16			65	694
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	1	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.708	1.000			0.954			0.910		0.759	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1509	2132			3122			3137		1414	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	491	1509	# 0.33	0.50	755	0.65
Prot							
Perm							
Thru	TR	39	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	72	3122	0.02	0.50	1561	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3137	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	65	1414	0.05	0.39	550	0.12
Right	R	694	1583	# 0.44	0.39	616	1.13

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.65	0.50	16.7	1.000	755	0.50	4.1	0.0	20.8	C			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	20.1	C	
Westbound													
LTR	0.05	0.50	11.5	1.000	1561	0.50	0.1	0.0	11.6	B	11.6	B	
Northbound													
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.12	0.39	17.6	1.000	550	0.50	0.4	0.0	18.0	B	95.6	F	

R 1.13 0.39 27.5 1.000 616 0.50 75.4 0.0 102.9 F

Intersection delay = 61.2 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	491			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	72			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	12.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.95			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.41			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.708			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	1	6	64
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375
Proportion of LT in opposing flow, PLTo	0.00	0.98	0.38
Adjusted opposing flow rate, Vo (veh/h)	39	65	16
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.60
Opposing lane util. factor, fLUo	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.49	1.63	0.21
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	5.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	29.83
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.02	0.63
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.98
EL1 (refer to Exhibit C16-3)	1.43	1.47	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.954	0.910	0.759

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	72	39	65	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.472	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	16.7	0.00	0.0	0.0	20.8
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.0
R	0.0	0.00	27.5	27.5	0.00	19.5	0.0	102.9
Intersection Delay			61.2	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	491	39			37				8				65	694	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1509	2132			1639				1647				1414	1583	
LnCapacity	755	1066			819				640				550	616	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.4	
v/c Ratio	0.65	0.04			0.05				0.01				0.12	1.13	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	9.1	0.5			0.5				0.1				1.0	17.4	
kB	0.9	1.1			1.0				0.8				0.7	0.8	
Q2	1.6	0.0			0.0				0.0				0.1	14.4	
Q Average	10.7	0.5			0.5				0.1				1.1	31.7	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	12.9	0.7			0.7				0.2				1.5	38.1	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	15.3	0.9			0.9				0.2				1.9	44.4	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			2.0				2.0				1.9	1.5	
BOQ	16.6	1.1			1.0				0.3				2.2	47.6	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.4	1.6	
BOQ	18.3	1.3			1.3				0.3				2.7	50.8	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.1				3.2				2.9	1.7	
BOQ	20.0	1.6			1.6				0.4				3.3	54.0	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	235		23				2	269			655	487
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.49	0.32	19.7	B	19.3	B
R	473	1495	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1727 3342 0.18 0.52 7.9 A 7.9 A

Southbound

TR 1944 3763 0.65 0.52 11.8 B 11.8 B

Intersection Delay = 12.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	235		23				2	269		655	487	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	68		7				1	76		180	134	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	270		20					308			1255	
%InSharedLn												
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.426	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	235		23				2	269		655	487	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	270		20				2	306		720	535	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	270		20					308			1255	
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.426	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.926	0.926			0.990	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.936		
fLT	0.950				0.949	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1727	1495			3342	3763		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	270	1727	# 0.16	0.32	547	0.49
Prot							
Perm							
Thru							
Right	R	20	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	308	3342	0.09	0.52	1727	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1255	3763	# 0.33	0.52	1944	0.65
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.49	0.32	16.6	1.000	547	0.50	3.1	0.0	19.7	B	19.3	B	
R	0.04	0.32	14.2	1.000	473	0.50	0.2	0.0	14.4	B			
Westbound													
Northbound													
LT	0.18	0.52	7.7	1.000	1727	0.50	0.2	0.0	7.9	A	7.9	A	
Southbound													
TR	0.65	0.52	10.5	1.000	1944	0.50	1.3	0.0	11.8	B	11.8	B	

Intersection delay = 12.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.006 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1255
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.99
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	11.75
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	5.05
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.949

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			11.75	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.379	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1255	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.006	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.426
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	16.6	0.00	0.0	0.0	19.7
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	7.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	10.5	0.00	0.0	0.0	11.8
	0.0						0.0	
Intersection Delay			12.4	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	270	20				161		659	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1727	1495				1755		1976	
LnCapacity	547	473				907		1021	
Flow Ratio	0.2	0.0				0.1		0.3	
v/c Ratio	0.49	0.04				0.18		0.65	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	3.6	0.2				1.4		8.0	
kB	0.5	0.5				0.8		0.7	
Q2	0.5	0.0				0.2		1.2	
Q Average	4.2	0.3				1.6		9.2	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	5.2	0.3				2.0		11.2	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	6.4	0.4				2.6		13.3	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.6	
BOQ	7.2	0.5				3.0		14.5	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.6				2.3		1.8	
BOQ	8.5	0.6				3.7		16.2	
QSRatio									
98th Percentile Output:									
fB%	2.4	3.1				2.8		1.9	
BOQ	9.8	0.8				4.5		17.8	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L	LT		L	LTR				
Volume	1	0		477	2		4			22	665	4
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	600	1439	0.45	0.42	14.9	B		
LT	576	1383	0.47	0.42	15.4	B	15.1	B

Northbound

L	216	518	0.02	0.42	10.5	B	10.5	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2059	4942	0.37	0.42	12.6	B	12.6	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 13.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		477	2		4			22	665	4
% Heavy Veh	1	1		3	3		1			1	1	1
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol	1	0		134	1		1			6	183	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			268	270		5			759		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.993		1.000				0.032	
Prop RTs	0.000			0.000						0.005		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.988		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		477	2		4			22	665	4
PHF	0.25	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	4	0		536	2		5			24	731	4
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	4			268	270		5			759		
Prop LTs	0.000			1.000 0.993			1.000			0.032		
Prop RTs	0.000			0.000						0.005		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.999	
fLT	1.000		0.755 0.726		0.295		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1439 1383		518		4942	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	268	1439	0.19	0.42	600	0.45
Prot							
Perm							
Thru	LT	270	1383	# 0.20	0.42	576	0.47
Right							
Northbound							
Prot							
Perm							
Left	L	5	518	0.01	0.42	216	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	759	4942	# 0.15	0.42	2059	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.35
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.45	0.42	12.5	1.000	600	0.50	2.4	0.0	14.9	B		
LT	0.47	0.42	12.7	1.000	576	0.50	2.7	0.0	15.4	B	15.1	B
Northbound												
L	0.02	0.42	10.3	1.000	216	0.50	0.2	0.0	10.5	B	10.5	B
Southbound												
LTR	0.37	0.42	12.1	1.000	2059	0.50	0.5	0.0	12.6	B	12.6	B

Intersection delay = 13.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		268	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		4	759	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.47	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	4.64	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	3.99	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	21.01	
n=Max(gq-gf)/2,0)		0.00	2.00	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.85	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.96	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	3.99	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.30	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.295	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	268		
Proportion of LT in LT lane group, PLT	0.000	0.993	0.032
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		4	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		4.47	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.99	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.726	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	4		268	270	5		278	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1439	1383	518		1814	
LnCapacity	784		600	576	216		755	
Flow Ratio	0.0		0.2	0.2	0.0		0.2	
v/c Ratio	0.01		0.45	0.47	0.02		0.37	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.983		0.988	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.2	3.3	0.0		3.2	
kB	0.7		0.6	0.6	0.3		0.7	
Q2	0.0		0.5	0.5	0.0		0.4	
Q Average	0.0		3.7	3.8	0.1		3.6	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.2	
BOQ	0.1		4.6	4.7	0.1		4.5	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.5	
BOQ	0.1		5.7	5.8	0.1		5.6	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.7	
BOQ	0.1		6.4	6.5	0.1		6.3	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.1	2.6		2.1	
BOQ	0.1		7.6	7.8	0.1		7.5	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.4	3.2		2.4	
BOQ	0.1		8.9	9.1	0.2		8.8	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	23
Peak-Hour Factor, PHF	0.71
Hourly Flow Rate, HFR	32
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	500
Peak Hour Factor, PHF	0.88
Hourly Flow Rate, HFR	568
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	568
C(m) (vph)	1045
v/c	0.54
95% queue length	3.38
Control Delay	12.5
LOS	B
Approach Delay	12.5
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.71				
Peak-15 Minute Volume		8				
Hourly Flow Rate, HFR		32				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			500			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			142			
Hourly Flow Rate, HFR			568			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					32			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	32	
Potential Capacity	1045	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1045	
Probability of Queue free St.	0.46	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.46
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.46
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			568			
Movement Capacity (vph)			1045			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1045			
Volume			568			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					568			
C(m) (vph)					1045			
v/c					0.54			
95% queue length					3.38			
Control Delay					12.5			
LOS					B			
Approach Delay				12.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	103	37	202	81	0	0	0	0	23	86	24
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	174		361				72 73	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	174		361				72	73
Left-Turn	0		258				25	0
Right-Turn	46		0				0	26
Prop. Left-Turns	0.0		0.7				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.4
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	37	88	0	0	219	19	63	97	138	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	155		304		111		188	
% Heavy Veh	2		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	155		304		111	188		
Left-Turn	46		0		63	0		
Right-Turn	0		24		0	139		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	187	194	142	7	46	8	434	102	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	550	1572	0.81	0.35	30.2	C	27.2	C
R	560	1599	0.19	0.35	14.3	B		

Westbound

LTR	528	1510	0.13	0.35	13.8	B	13.8	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2300	4759	0.26	0.48	9.4	A	9.4	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	187	194	142	7	46	8	434	102	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	55	57	42	2	13	2	122	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		448	105		70			605				
%InSharedLn												
Prop LTs		0.491			0.114			0.807				
Prop RTs		0.000	1.000		0.129			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	187	194	142	7	46	8	434	102	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	220	228	105	8	53	9	488	115	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group		LT	R		LTR			LTR				
Adj flow		448	105		70			605				
Prop LTs		0.491			0.114			0.807				
Prop RTs		0.000	1.000		0.129			0.003				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.990	0.990	0.990		0.990			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.983		1.000			
fLT	0.809		0.949		0.961			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1572	1599	1510		4759			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.81	0.35	17.7	1.000	550	0.50	12.5	0.0	30.2	C	27.2	C
R	0.19	0.35	13.6	1.000	560	0.50	0.7	0.0	14.3	B		
Westbound												
LTR	0.13	0.35	13.3	1.000	528	0.50	0.5	0.0	13.8	B	13.8	B
Northbound												
LTR	0.26	0.48	9.2	1.000	2300	0.50	0.3	0.0	9.4	A	9.4	A
Southbound												

Intersection delay = 17.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	220	8	
Proportion of LT in LT lane group, PLT	0.491	0.114	0.807
Proportion of LT in opposing flow, PLTo	0.11	0.49	
Adjusted opposing flow rate, Vo (veh/h)	70	448	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.67	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.17	7.47	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	9.48	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.89	0.51	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.49	0.11	
EL1 (refer to Exhibit C16-3)	1.48	2.18	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.809	0.949	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	9.48		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.452		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	70	448	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.491	0.114	0.807	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.129	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	17.7	0.00	0.0	0.0	30.2
R	0.0	0.00	19.5	13.6	0.00	0.0	0.0	14.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.3	0.00	0.0	0.0	13.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			17.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	448	105	70	222			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1 0	0 3 0	0 0 0		
SL	1572	1599	1510	1747			
LnCapacity	550	560	528	844			
Flow Ratio	0.3	0.1	0.0	0.1			
v/c Ratio	0.81	0.19	0.13	0.26			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	6.8	1.2	0.8	2.2			
kB	0.6	0.6	0.5	0.7			
Q2	2.1	0.1	0.1	0.3			
Q Average	8.9	1.3	0.9	2.5			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	10.9	1.7	1.1	3.1			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.6	1.7	1.6			
BOQ	12.9	2.2	1.5	3.9			
QSRatio							
90th Percentile Output:							
fB%	1.6	1.9	1.9	1.8			
BOQ	14.1	2.5	1.7	4.4			
QSRatio							
95th Percentile Output:							
fB%	1.8	2.4	2.4	2.2			
BOQ	15.8	3.2	2.1	5.4			
QSRatio							
98th Percentile Output:							
fB%	2.0	2.8	3.0	2.6			
BOQ	17.4	3.8	2.6	6.4			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	163		33				18	451		451	44	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	458	1717	0.45	0.27	21.4	C	21.4	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1099	1939	0.50	0.57	9.2	A	9.2	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1127	1988	0.48	0.57	9.0	A	9.0	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 11.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	163		33				18	451		451	44	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	42		9				5	131		123	12	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		204						545			538	
%InSharedLn												
Prop LTs		0.833						0.039			0.000	
Prop RTs		0.167						0.000			0.089	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	163		33				18	451		451	44	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	170		34				21	524		490	48	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		204						545			538	
Prop LTs		0.833						0.039			0.000	
Prop RTs		0.167						0.000			0.089	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.978						1.000			0.988		
fLT	0.960						0.974			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1717						1939			1988		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	204	1717	# 0.12	0.27	458	0.45
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	545	1939	# 0.28	0.57	1099	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	538	1988	0.27	0.57	1127	0.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.45	0.27	18.3	1.000	458	0.50	3.1	0.0	21.4	C	21.4	C
Westbound												
Northbound												
LT	0.50	0.57	7.8	1.000	1099	0.50	1.4	0.0	9.2	A	9.2	A
Southbound												
TR	0.48	0.57	7.7	1.000	1127	0.50	1.3	0.0	9.0	A	9.0	A

Intersection delay = 11.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		21	
Proportion of LT in LT lane group, PLT	0.833	0.039	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		538	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.35	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.97	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		16.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		5.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.39	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.974	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.83	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.171	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			538	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.039	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.089
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.3	0.00	0.0	0.0	21.4
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.8	0.00	0.0	0.0	9.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.7	0.00	0.0	0.0	9.0
	0.0						0.0	
Intersection Delay			11.1	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	204						545			538		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1717						1939			1988		
LnCapacity	458						1099			1127		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.45						0.50			0.48		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.8						5.5			5.3		
kB	0.5						0.8			0.8		
Q2	0.4						0.8			0.8		
Q Average	3.2						6.3			6.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	4.0						7.7			7.5		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	5.0						9.3			9.1		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	5.7						10.3			10.0		
QSRatio												
95th Percentile Output:												
fB%	2.1						1.9			1.9		
BOQ	6.8						11.8			11.5		
QSRatio												
98th Percentile Output:												
fB%	2.5						2.1			2.1		
BOQ	8.0						13.3			13.0		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrots Road

Inter.: Sharrots Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	143		83				22	506		388	219	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								21	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	573	1719	0.49	0.33	18.7	B	18.7	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	892	1783	0.69	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	970	1939	0.66	0.50	14.2	B	14.2	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 15.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	143		83				22	506		388	219	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	45		26				6	147		105	60	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		283						614			637	
%InSharedLn												
Prop LTs		0.633						0.042			0.000	
Prop RTs		0.367						0.000			0.338	
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	143		83				22	506		388	219	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	179		104				26	588		422	215	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		283						614			637	
Prop LTs		0.633						0.042			0.000	
Prop RTs		0.367						0.000			0.338	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.950						1.000			0.954		
fLT	0.969						0.964			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1719						1783			1939		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	283	1719	# 0.16	0.33	573	0.49
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	614	1783	# 0.34	0.50	892	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	637	1939	0.33	0.50	970	0.66
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.51

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.49	0.33	16.0	1.000	573	0.50	2.8	0.0	18.7	B	18.7	B
Westbound												
Northbound												
LT	0.69	0.50	11.4	1.000	892	0.50	3.6	0.0	15.1	B	15.1	B
Southbound												
TR	0.66	0.50	11.2	1.000	970	0.50	3.1	0.0	14.2	B	14.2	B

Intersection delay = 15.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		26		
Proportion of LT in LT lane group, PLT	0.633	0.042	0.000	
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		637		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		0.43		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.62		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		13.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		9.34		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.95		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04		
EL1 (refer to Exhibit C16-3)		2.63		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.964		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			9.34	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.311	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		637	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.633		0.042	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.367	0.338
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.0	0.00	0.0	0.0	18.7
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.4	0.00	0.0	0.0	15.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	11.2	0.00	0.0	0.0	14.2
	0.0						0.0	
Intersection Delay			15.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	283						614			637		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1719						1783			1939		
LnCapacity	573						892			970		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.49						0.69			0.66		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.8						7.8			7.9		
kB	0.5						0.7			0.7		
Q2	0.5						1.4			1.4		
Q Average	4.3						9.2			9.3		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.3						11.2			11.3		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.5						13.3			13.4		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.3						14.5			14.6		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.8		
BOQ	8.7						16.2			16.3		
QSRatio												
98th Percentile Output:												
fB%	2.3						1.9			1.9		
BOQ	10.0						17.8			17.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		145	266	450	266	83	198		479	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	38.8	D
R	220	1652	0.70	0.13	39.2	D		
Westbound								
LTR	1329	4689	0.84	0.28	23.6	C	23.6	C
Northbound								
L	124	373	0.73	0.33	46.5	D		
T	616	1848	0.35	0.33	16.5	B	25.4	C
Southbound								
TR	670	2010	0.83	0.33	28.6	C	28.6	C

Intersection Delay = 26.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		145	266	450	266	83	198		479	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		38	76	128	76	23	54		138	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		153		1115		90	215			557	
%InSharedLn												
Prop LTs					0.271		1.000	0.000			0.000	
Prop RTs			1.000		0.271			0.000			0.011	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		145	266	450	266	83	198		479	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		153	302	511	302	90	215		551	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		153		1115		90	215		557		
Prop LTs					0.271		1.000	0.000		0.000		
Prop RTs			1.000		0.271		0.000			0.011		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.990		0.980	0.980	0.962	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.972	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.959			1.000	0.999	
fLT	0.950		0.987		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4689		373	1848	2010	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	153	1652	# 0.09	0.13	220	0.70
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1115	4689	# 0.24	0.28	1329	0.84
Right							
Northbound							
Prot							
Perm							
Left	L	90	373	0.24	0.33	124	0.73
Prot							
Perm							
Thru	T	215	1848	0.12	0.33	616	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	557	2010	# 0.28	0.33	670	0.83
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	38.8	D	
R	0.70	0.13	24.8	1.000	220	0.50	14.3	0.0	39.2	D			
Westbound													
LTR	0.84	0.28	20.2	1.000	1329	0.50	3.4	0.0	23.6	C	23.6	C	
Northbound													
L	0.73	0.33	17.6	1.000	124	0.50	28.9	0.0	46.5	D	25.4	C	
T	0.35	0.33	15.1	1.000	616	0.50	1.4	0.0	16.5	B			
Southbound													
TR	0.83	0.33	18.4	1.000	670	0.50	10.1	0.0	28.6	C	28.6	C	

Intersection delay = 26.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			90	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			557	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.50	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.28	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			12.56	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			7.44	
n=Max(gq-gf)/2,0)			6.28	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.20	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.271 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			12.56	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.628	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			557	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.271	0.011
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	24.8	0.00	0.0	0.0	39.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.2	0.00	0.0	0.0	23.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	17.6	0.00	0.0	0.0	46.5
T	0.0	0.00	20.0	15.1	0.00	0.0	0.0	16.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.4	0.00	0.0	0.0	28.6
	0.0						0.0	
Intersection Delay			26.3	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	153		409		90	215		557
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1721		373	1848		2010
LnCapacity	222	220		487		124	616		670
Flow Ratio	0.0	0.1		0.2		0.2	0.1		0.3
v/c Ratio	0.02	0.70		0.84		0.73	0.35		0.83
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	2.4		6.4		1.3	2.7		8.6
kB	0.3	0.3		0.3		0.2	0.6		0.6
Q2	0.0	0.5		1.2		0.4	0.3		2.4
Q Average	0.1	3.0		7.6		1.8	3.0		10.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	3.7		9.3		2.2	3.8		13.2
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.4
BOQ	0.1	4.7		11.2		2.8	4.7		15.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.1	5.3		12.3		3.3	5.3		17.0
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		1.8		2.3	2.1		1.7
BOQ	0.2	6.4		13.9		4.1	6.5		18.7
QSRatio									
98th Percentile Output:									
fB%	3.2	2.5		2.0		2.8	2.5		1.9
BOQ	0.2	7.5		15.4		4.9	7.6		20.4
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	9	20	6				8	272	118	308	533	50
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 460 1623 0.12 0.28 16.5 B 16.5 B

Westbound

Northbound

LTR 957 1740 0.45 0.55 9.5 A 9.5 A

Southbound

L 514 935 0.64 0.55 12.9 B
 TR 986 1792 0.62 0.55 10.9 B 11.6 B

Intersection Delay = 11.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	20	6				8	272	118	308	533	50
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				2	74	32	83	143	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		56						433		331	614	
%InSharedLn												
Prop LTs		0.250						0.021		1.000	0.000	
Prop RTs		0.179						0.296			0.067	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	20	6				8	272	118	308	533	50
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
Adj flow	14	32	10				9	296	128	331	573	41
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	56						433			331	614	
Prop LTs	0.250						0.021			1.000	0.000	
Prop RTs	0.179						0.296			0.067		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.980	0.980	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.992			1.000	0.972	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.976							0.960				0.990	
fLT	0.988							0.989			0.502	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1623							1740			935	1792	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	56	1623	# 0.03	0.28	460	0.12
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	433	1740	0.25	0.55	957	0.45
Right							
Southbound							
Prot							
Perm							
Left	L	331	935	# 0.35	0.55	514	0.64
Prot							
Perm							
Thru	TR	614	1792	0.34	0.55	986	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.12	0.28	16.0	1.000	460	0.50	0.5	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.45	0.55	8.1	1.000	957	0.50	1.4	0.0	9.5	A	9.5	A
Southbound												
L	0.64	0.55	9.4	1.000	514	0.50	3.5	0.0	12.9	B		
TR	0.62	0.55	9.2	1.000	986	0.50	1.7	0.0	10.9	B	11.6	B

Intersection delay = 11.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				331
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				433
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.52
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.22
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.55
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.45
n=Max(gq-gf)/2,0)				2.28
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.96
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.25
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				4.55
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.50
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.502

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		9	
Proportion of LT in LT lane group, PLT	0.250	0.021	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		614	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.15	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.23	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		7.46	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		11.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.57	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.989	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.46	4.55
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.226	0.138
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			614	433
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.021	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.179	0.296	0.067
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.0	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.1	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.4	0.00	0.0	0.0	12.9
TR	0.0	0.00	13.5	9.2	0.00	0.0	0.0	10.9
	0.0						0.0	

Intersection Delay	11.2	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	56						433			331	614	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1623						1740			935	1792	
LnCapacity	460						957			514	986	
Flow Ratio	0.0						0.2			0.4	0.3	
v/c Ratio	0.12						0.45			0.64	0.62	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.922				0.564	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	0.7						4.3			3.8	7.0	
kB	0.5						0.8			0.3	0.5	
Q2	0.1						0.6			0.5	0.8	
Q Average	0.8						5.0			4.4	7.8	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	1.0						6.1			5.4	9.5	
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.5	1.5	
BOQ	1.3						7.5			6.7	11.4	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7	1.6	
BOQ	1.5						8.3			7.5	12.5	
QSRatio												
95th Percentile Output:												
fB%	2.5						2.0			2.0	1.8	
BOQ	1.9						9.8			8.8	14.1	
QSRatio												
98th Percentile Output:												
fB%	3.0						2.3			2.3	2.0	
BOQ	2.3						11.2			10.2	15.7	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	6	12	20	258	28	106	18	286	169	91	413	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 632 1421 0.09 0.44 14.7 B 14.7 B

Westbound

L 560 1261 0.53 0.44 21.4 C
 T 792 1783 0.04 0.44 14.2 B 19.4 B
 R 585 1316 0.21 0.44 16.0 B

Northbound

LTR 731 1644 0.70 0.44 24.0 C 24.0 C

Southbound

LTR 633 1425 0.93 0.44 30.9 C 30.9 C

Intersection Delay = 25.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	12	20	258	28	106	18	286	169	91	413	9
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	4	7	74	8	30	5	78	46	26	119	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		55		297	32	122		515			590	
%InSharedLn												
Prop LTs		0.164		1.000	0.000			0.039			0.178	
Prop RTs		0.527			0.000	1.000		0.357			0.017	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	12	20	258	28	106	18	286	169	91	413	9
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	17	29	297	32	122	20	311	184	105	475	10
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	55			297	32	122	515			590		
Prop LTs	0.164			1.000	0.000	0.000	0.039			0.178		
Prop RTs	0.527			0.000 1.000			0.357			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.929		1.000 0.850			0.952		0.998		
fLT	0.975		0.721	1.000		0.969		0.770		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.996		
fRpb	0.970		1.000 1.000			0.980		1.000		
S	1421		1261	1783	1316	1644		1425		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	55	1421	0.04	0.44	632	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	297	1261	# 0.24	0.44	560	0.53
Prot							
Perm							
Thru	T	32	1783	0.02	0.44	792	0.04
Right	R	122	1316	0.09	0.44	585	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	515	1644	0.31	0.44	731	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	590	1425	# 0.41	0.44	633	0.93
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.4	1.000	632	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.53	0.44	18.2	1.000	560	0.50	3.2	0.0	21.4	C		
T	0.04	0.44	14.1	1.000	792	0.50	0.1	0.0	14.2	B	19.4	B
R	0.21	0.44	15.3	1.000	585	0.50	0.7	0.0	16.0	B		
Northbound												
LTR	0.70	0.44	20.2	1.000	731	0.50	3.8	0.0	24.0	C	24.0	C
Southbound												
LTR	0.93	0.44	23.7	1.000	633	0.50	7.2	0.0	30.9	C	30.9	C

Intersection delay = 25.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		297		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		55		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.43		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.38		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.721		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	105
Proportion of LT in LT lane group, PLT	0.164	0.000	0.039
Proportion of LT in opposing flow, PLTo	0.00	0.18	0.04
Adjusted opposing flow rate, Vo (veh/h)	32	590	515
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.63
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.80	14.75	12.88
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	17.9	3.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.60	13.57
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	22.06	26.43
n=Max(gq-gf)/2,0)	0.00	0.00	5.16
PTHo=1-PLTo	1.00	0.82	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.18
EL1 (refer to Exhibit C16-3)	1.42	2.51	2.33
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.76
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.31
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.97	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.975	0.969	0.770

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.60	13.57
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.390	0.339
OCCpedu	0.000	0.056	0.000	0.047
Opposing flow rate, Vo (veh/h)	32	55	590	515
OCCr	0.000	0.052	0.000	0.023
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.977
Proportion of left turns, PLT	0.164	1.000	0.039	0.178
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.527	1.000	0.357	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.970	1.000	0.980	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.4	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.2	0.00	0.0	0.0	21.4
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.2	0.00	0.0	0.0	24.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	23.7	0.00	0.0	0.0	30.9
	0.0						0.0	
Intersection Delay			25.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		55	297	32	122		515		590
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	1
SL		1421	1261	1783	1316		1644		1425
LnCapacity		632	560	792	585		731		633
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.4
v/c Ratio		0.09	0.53	0.04	0.21		0.70		0.93
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.905			0.663		0.229
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.8	5.4	0.5	1.9		10.4		14.0
kB		0.8	0.7	0.9	0.7		0.6		0.2
Q2		0.1	0.8	0.0	0.2		1.4		1.9
Q Average		0.9	6.2	0.5	2.1		11.8		15.9
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.1	7.6	0.6	2.6		14.3		19.2
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.4	9.2	0.8	3.3		16.8		22.5
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.7	10.1	1.0	3.8		18.2		24.2
QSRatio									
95th Percentile Output:									
fB%		2.4	1.9	2.5	2.3		1.7		1.6
BOQ		2.1	11.6	1.2	4.6		20.0		26.1
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.8		1.8
BOQ		2.6	13.2	1.5	5.5		21.7		28.0
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/17/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	170		245	133	185		139		134			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	934	1868	0.46	0.50	16.2	B	16.2	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	547	1093	0.70	0.50	24.5	C	24.5	C
----	-----	------	------	------	------	---	------	---

Northbound

LR	564	1449	0.72	0.39	30.5	C	30.5	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 23.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		170	245	133	185		139		134			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		52	75	40	56		52		50			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59					0				
Adj Flow		434			383			407				
%InSharedLn												
Prop LTs		0.000			0.418			0.509				
Prop RTs		0.523			0.000			0.491				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		170	245	133	185		139		134			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		207	227	160	223		207		200			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		434			383			407				
Prop LTs		0.000			0.418			0.509				
Prop RTs		0.523			0.000			0.491				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.929			1.000			0.934					
fLT	1.000			0.548			0.975					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1868			1093			1449					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 23.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	160		
Proportion of LT in LT lane group, PLT	0.000	0.418	0.509
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	434		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	4.00		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.85		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.8		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	9.57		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.43		
n=Max(gq-gf)/2,0)	4.41		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42		
EL1 (refer to Exhibit C16-3)	2.15		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.55		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.548		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.7	0.00	0.0	0.0	16.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	17.3	0.00	0.0	0.0	24.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	23.4	0.00	0.0	0.0	30.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			23.6	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		434			383			407				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1868			1093			1449				
LnCapacity		934			547			564				
Flow Ratio		0.2			0.4			0.3				
v/c Ratio		0.46			0.70			0.72				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.989			0.917				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		7.1			7.4			8.6				
kB		1.0			0.7			0.7				
Q2		0.9			1.6			1.7				
Q Average		7.9			9.0			10.3				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		9.7			10.9			12.5				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.4				
BOQ		11.6			13.0			14.8				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.6			1.6				
BOQ		12.7			14.2			16.1				
QSRatio												
95th Percentile Output:												
fB%		1.8			1.8			1.7				
BOQ		14.3			15.8			17.8				
QSRatio												
98th Percentile Output:												
fB%		2.0			1.9			1.9				
BOQ		15.9			17.5			19.5				
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	26	32	23	60	17	40	11	244	49	28	274	27
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 238 2039 0.85 0.12 55.6 E 55.6 E

Westbound

LTR 501 2003 0.30 0.25 19.8 B 19.8 B

Northbound

LTR 764 1993 0.43 0.38 15.5 B 15.5 B

Southbound

LTR 733 1913 0.51 0.38 16.7 B 16.7 B

Intersection Delay = 24.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/2013
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	26	32	23	60	17	40	11	244	49	28	274	27
% Heavy Veh	0	0	0	0	0	0	3	3	3	5	5	5
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
PK 15 Vol	16	20	14	19	5	13	3	66	13	8	78	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		202			150			330			374	
%InSharedLn												
Prop LTs		0.322			0.513			0.036			0.086	
Prop RTs		0.282			0.340			0.161			0.083	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	26	32	23	60	17	40	11	244	49	28	274	27
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
Adj flow	65	80	57	77	22	51	12	265	53	32	311	31
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	202			150			330			374		
Prop LTs	0.322			0.513			0.036			0.086		
Prop RTs	0.282			0.340			0.161			0.083		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	1.000			1.000			0.971			0.952		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.962			0.954			0.978			0.989		
fLT	0.984			0.975			0.982			0.951		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2039			2003			1993			1913		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	202	2039	# 0.10	0.12	238	0.85
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	150	2003	# 0.07	0.25	501	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	330	1993	0.17	0.38	764	0.43
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	374	1913	# 0.20	0.38	733	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.37
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.49

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.85	0.12	26.0	1.000	238	0.50	29.6	0.0	55.6	E	55.6	E	
Westbound													
LTR	0.30	0.25	18.2	1.000	501	0.50	1.5	0.0	19.8	B	19.8	B	
Northbound													
LTR	0.43	0.38	13.7	1.000	764	0.50	1.8	0.0	15.5	B	15.5	B	
Southbound													
LTR	0.51	0.38	14.2	1.000	733	0.50	2.5	0.0	16.7	B	16.7	B	

Intersection delay = 24.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			12	32
Proportion of LT in LT lane group, PLT	0.322	0.513	0.036	0.086
Proportion of LT in opposing flow, PLTo			0.09	0.04
Adjusted opposing flow rate, Vo (veh/h)			374	330
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.20	0.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.23	5.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			11.8	7.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			6.93	5.85
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.17	15.11
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.91	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.04	0.09
EL1 (refer to Exhibit C16-3)			2.03	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.09
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.982	0.951

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.85
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.254
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				330
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.086
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.282	0.161
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	26.0	0.00	0.0	0.0	55.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.2	0.00	0.0	0.0	19.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	13.7	0.00	0.0	0.0	15.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Intersection Delay			24.2	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	202		150		330		374	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	1 0	0 0	1 0	0 0	1 0	0 0
SL	2039		2003		1993		1913	
LnCapacity	238		501		764		733	
Flow Ratio	0.1		0.1		0.2		0.2	
v/c Ratio	0.85		0.30		0.43		0.51	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	3.3		2.0		4.1		4.8	
kB	0.3		0.5		0.7		0.7	
Q2	1.4		0.2		0.5		0.7	
Q Average	4.7		2.3		4.6		5.5	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.2		1.2	
BOQ	5.8		2.8		5.7		6.8	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.5		1.5	
BOQ	7.1		3.6		7.0		8.2	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.7		1.7	
BOQ	7.9		4.1		7.8		9.1	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.2		2.0		1.9	
BOQ	9.3		5.0		9.2		10.6	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.7		2.3		2.2	
BOQ	10.7		6.0		10.6		12.1	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			286	12		16	341	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			310	13		18	387	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		9		19				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		12		25				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			18			37					
C(m) (vph)			1220			557					
v/c			0.01			0.07					
95% queue length			0.04			0.21					
Control Delay			8.0			11.9					
LOS			A			B					
Approach Delay						11.9					
Approach LOS						B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		286	12	16	341	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		78	3	5	97	
Hourly Flow Rate, HFR		310	13	18	387	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	9		19			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	3		6			
Hourly Flow Rate, HFR	12		25			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		387
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		323	739		316			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	316	
Potential Capacity	722	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	722	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	323	
Potential Capacity	1220	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1220	
Probability of Queue free St.	0.99	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	739	
Potential Capacity	383	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.99
Cap. Adj. factor due to Impeding mvmnt	0.99	0.95
Movement Capacity	377	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 739
Potential Capacity 383
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.99
Cap. Adj. factor due to Impeding mvmnt 0.99 0.95
Movement Capacity 377

Results for Two-stage process:
a
y
C t 377

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	12		25			
Movement Capacity (vph)	377		722			
Shared Lane Capacity (vph)		557				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	377		722			
Volume	12		25			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		557				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement Lane Config	1	4 LT	7	8 LR	9	10	11	12
v (vph)		18		37				
C(m) (vph)		1220		557				
v/c		0.01		0.07				
95% queue length		0.04		0.21				
Control Delay		8.0		11.9				
LOS		A		B				
Approach Delay				11.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.99
v(i1), Volume for stream 2 or 5		387
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	9	5	382	26	389	5	162	388	196	204	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	724	1738	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	547	1312	0.81	0.42	26.0	C	25.3	C
R	539	1293	0.78	0.42	24.6	C		

Northbound

LTR	742	1782	0.82	0.42	24.2	C	24.2	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	389	934	1.13	0.42	102.9	F	102.9	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 42.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	9	5	382	26	389	5	162	388	196	204	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	104	7	106	2	45	107	54	56	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		15			443	423		609			439	
%InSharedLn												
Prop LTs		0.000			0.937			0.008			0.490	
Prop RTs		0.333			0.000	1.000		0.700			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	9	5	382	26	389	5	162	388	196	204	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	10	5	415	28	423	5	178	426	215	224	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	15			443 423			609			439		
Prop LTs	0.000			0.937			0.008			0.490		
Prop RTs	0.333			0.000 1.000			0.700			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.955			1.000 0.850			0.906			1.000		
fLT	1.000			0.729			0.997			0.451		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1738			1312 1293			1782			934		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	15	1738	0.01	0.42	724	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	443	1312	# 0.34	0.42	547	0.81
Right	R	423	1293	0.33	0.42	539	0.78
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	609	1782	0.34	0.42	742	0.82
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	439	934	# 0.47	0.42	389	1.13
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.81
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.97

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	724	0.50	0.1	0.0	10.3	B	10.3	B
Westbound												
LT	0.81	0.42	15.4	1.000	547	0.50	10.6	0.0	26.0	C	25.3	C
R	0.78	0.42	15.2	1.000	539	0.50	9.4	0.0	24.6	C		
Northbound												
LTR	0.82	0.42	15.5	1.000	742	0.50	8.6	0.0	24.2	C	24.2	C
Southbound												
LTR	1.13	0.42	17.5	1.000	389	0.50	85.4	0.0	102.9	F	102.9	F

Intersection delay = 42.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	415	5	215
Proportion of LT in LT lane group, PLT	0.000	0.937	0.008	0.490
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.49	0.01
Adjusted opposing flow rate, Vo (veh/h)	443	15	439	609
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	6.92	0.08	3.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.38	0.25	7.32	10.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	7.80	0.00	7.71	11.31
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.20	25.00	9.12	13.69
n=Max(gq-gf)/2,0)	3.90	0.00	0.00	5.66
PTHo=1-PLTo	0.06	1.00	0.51	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.49
EL1 (refer to Exhibit C16-3)	2.17	1.40	2.16	2.56
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07		1.00	5.55
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	7.80	0.00	0.00	11.31
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69	0.73	1.00	0.45
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.729	0.997	0.451

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	7.80		7.71	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.312		0.309	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	443		439	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.4	0.00	0.0	0.0	26.0
R	0.0	0.00	17.5	15.2	0.00	0.0	0.0	24.6
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.5	0.00	0.0	0.0	24.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	12.5	0.0	102.9
	0.0						0.0	
Intersection Delay			42.5	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	15			443	423	609			439			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1738			1312	1293	1782			934			
LnCapacity	724			547	539	742			389			
Flow Ratio	0.0			0.3	0.3	0.3			0.5			
v/c Ratio	0.02			0.81	0.78	0.82			1.13			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.849		0.861			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			6.5	6.1	9.0			7.3			
kB	0.7			0.5	0.5	0.6			0.4			
Q2	0.0			1.8	1.6	2.4			9.0			
Q Average	0.2			8.3	7.7	11.4			16.3			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			10.1	9.4	13.8			19.6			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.4			1.4			
BOQ	0.3			12.1	11.2	16.3			23.0			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.6	1.6			1.5			
BOQ	0.3			13.2	12.3	17.7			24.7			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.8	1.8	1.7			1.6			
BOQ	0.4			14.8	13.9	19.4			26.7			
QSRatio												
98th Percentile Output:												
fB%	3.2			2.0	2.0	1.9			1.8			
BOQ	0.5			16.5	15.5	21.1			28.6			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				437		8		546			590	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2027 0.76 0.33 21.9 C 21.9 C

Northbound

T 1026 2051 0.58 0.50 12.7 B 12.7 B

Southbound

T 1027 2054 0.63 0.50 12.0 B 12.0 B

Intersection Delay = 15.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				437		8	546			590		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				127		2	150			162		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					517		600			648		
%InSharedLn												
Prop LTs					0.983		0.000			0.000		
Prop RTs					0.017		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				437		8	546			590		
PHF				0.86		0.86	0.91			0.91		
Adj flow				508		9	600			648		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					517			600			648	
Prop LTs					0.983			0.000			0.000	
Prop RTs					0.017			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.998			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2027			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	517	2027	# 0.26	0.33	676	0.76
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	600	2051	0.29	0.50	1026	0.58
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	648	2054	# 0.32	0.50	1027	0.63
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.57

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.68

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.76	0.33	17.9	1.000	676	0.50	4.0	0.0	21.9	C	21.9	C	
Northbound													
T	0.58	0.50	10.6	1.000	1026	0.50	2.1	0.0	12.7	B	12.7	B	
Southbound													
T	0.63	0.50	11.0	1.000	1027	0.50	1.1	0.0	12.0	B	12.0	B	

Intersection delay = 15.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.983 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	17.9	0.00	0.0	0.0	21.9
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.6	0.00	0.0	0.0	12.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.0	0.00	0.0	0.0	12.0
	0.0						0.0	
Intersection Delay			15.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		546	262			175	853	
Peak-Hour Factor, PHF		0.91	0.91			0.91	0.91	
Hourly Flow Rate, HFR		599	287			192	937	
Percent Heavy Vehicles		--	--			6	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		192						
C(m) (vph)		748						
v/c		0.26						
95% queue length		1.02						
Control Delay		11.5						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		546	262	175	853	
Peak-Hour Factor, PHF		0.91	0.91	0.91	0.91	
Peak-15 Minute Volume		150	72	48	234	
Hourly Flow Rate, HFR		599	287	192	937	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		937
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		886						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	886	
Potential Capacity	748	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	748	
Probability of Queue free St.	0.74	1.00
Maj L-Shared Prob Q free St.	0.43	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.43	0.43
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.74	0.74
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		192						
C(m) (vph)		748						
v/c		0.26						
95% queue length		1.02						
Control Delay		11.5						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.74
v(il), Volume for stream 2 or 5		937
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.43
d(M,LT), Delay for stream 1 or 4		11.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		6.6

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				104		197	593	90		138	689	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 393 1475 0.86 0.27 41.0 D 41.0 D

Northbound

TR 1131 1996 0.66 0.57 11.5 B 11.5 B

Southbound

LT 717 1266 1.27 0.57 136.7 F 136.7 F

Intersection Delay = 73.4 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				104		197	593	90		138	689	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				29		55	163	25		38	189	
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					338			751			909	
%InSharedLn												
Prop LTs					0.346			0.000			0.167	
Prop RTs					0.654			0.132			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				104		197	593	90		138	689	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				117		221	652	99		152	757	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					338			751			909	
Prop LTs					0.346			0.000			0.167	
Prop RTs					0.654			0.132			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.912			0.982			1.000	
fLT					0.983			1.000			0.623	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1475			1996			1266	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	338	1475	# 0.23	0.27	393	0.86
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	751	1996	0.38	0.57	1131	0.66
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	909	1266	# 0.72	0.57	717	1.27
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.95
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.14

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR 0.86 0.27 20.9 1.000 393 0.50 20.1 0.0 41.0 D 41.0 D

Northbound

TR 0.66 0.57 9.0 1.000 1131 0.50 2.4 0.0 11.5 B 11.5 B

Southbound

LT 1.27 0.57 13.0 1.000 717 0.50 123.7 0.0 136.7 F 136.7 F

Intersection delay = 73.4 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			152
Proportion of LT in LT lane group, PLT	0.346	0.000	0.167
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			751
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.53
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.52
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			2.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.96
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.04
n=Max(gq-gf)/2,0)			3.35
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.17
EL1 (refer to Exhibit C16-3)			2.94
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.62
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.623

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.96
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.264
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				751
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.167
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.654	0.132
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.9	0.00	0.0	0.0	41.0
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.0	0.00	0.0	0.0	11.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	48.0	0.0	136.7
	0.0						0.0	
Intersection Delay			73.4	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	101	45	99	29	88	50	144	743	138	37	591	96
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	509	1478	0.62	0.34	27.5	C	27.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	544	1578	0.42	0.34	25.0	C	25.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	298	548	0.53	0.54	16.8	B		
TR	1067	1959	0.90	0.54	25.5	C	24.2	C

Southbound

LTR	1132	2080	0.68	0.54	17.9	B	17.9	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 22.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	101	45	99	29	88	50	144	743	138	37	591	96
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	32	14	32	10	30	17	39	202	37	10	161	26
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		314			229		157	958			765	
%InSharedLn												
Prop LTs		0.411			0.175		1.000	0.000			0.052	
Prop RTs		0.404			0.297			0.157			0.108	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	101	45	99	29	88	50	144	743	138	37	591	96
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	129	58	127	40	121	68	157	808	150	40	642	83
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	314			229			157 958			765		
Prop LTs	0.411			0.175			1.000 0.000			0.052		
Prop RTs	0.404			0.297			0.157			0.108		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.945			0.960			0.977			0.984		
fLT	0.726			0.908			0.312 1.000			0.663		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1478			1578			548 1959			2080		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	314	1478	# 0.21	0.34	509	0.62
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	229	1578	0.15	0.34	544	0.42
Right							
Northbound							
Prot							
Perm							
Left	L	157	548	0.29	0.54	298	0.53
Prot							
Perm							
Thru	TR	958	1959	# 0.49	0.54	1067	0.90
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	765	2080	0.37	0.54	1132	0.68
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.62	0.34	24.6	1.000	509	0.50	3.0	0.0	27.5	C	27.5	C
Westbound												
LTR	0.42	0.34	22.6	1.000	544	0.50	2.4	0.0	25.0	C	25.0	C
Northbound												
L	0.53	0.54	13.1	1.000	298	0.50	3.7	0.0	16.8	B		
TR	0.90	0.54	18.3	1.000	1067	0.50	7.2	0.0	25.5	C	24.2	C
Southbound												
LTR	0.68	0.54	14.8	1.000	1132	0.50	3.1	0.0	17.9	B	17.9	B

Intersection delay = 22.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			157	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.05	
Adjusted opposing flow rate, Vo (veh/h)			765	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			3.93	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.04	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			6.78	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.22	
n=Max(gq-gf)/2,0)			3.39	
PTHo=1-PLTo			0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.76	
EL2=Max((1-Ptho**n)/Plto, 1.0)			3.18	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			6.78	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.31	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.312	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	129	40	40
Proportion of LT in LT lane group, PLT	0.411	0.175	0.000
Proportion of LT in opposing flow, PLTo	0.17	0.41	0.00
Adjusted opposing flow rate, Vo (veh/h)	229	314	958
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	3.23	1.00	1.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.72	7.85	23.95
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.1	8.1	15.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	6.94	10.18	41.65
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.06	20.82	7.35
n=Max(gq-gf)/2,0)	3.40	1.03	13.18
PTHo=1-PLTo	0.83	0.59	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.41	0.17	0.17
EL1 (refer to Exhibit C16-3)	1.75	1.91	3.59
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.74	1.02	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.08	0.05
gdifff=max(gq-gf,0)	6.79	2.06	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73	0.91	0.42
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726	0.908	0.663

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	6.94	10.18	6.78	41.65
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.224	0.328	0.138	0.850
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	229	314	765	958
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.411	0.175	1.000	0.052
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.404	0.297	0.157	0.108
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	24.6	0.00	0.0	0.0	27.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.6	0.00	0.0	0.0	25.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	13.1	0.00	0.0	0.0	16.8
TR	0.0	0.00	20.5	18.3	0.00	0.0	0.0	25.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	14.8	0.00	0.0	0.0	17.9
	0.0						0.0	
Intersection Delay			22.7	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	314		229		157	958	401	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1478		1578		548	1959	1092	
LnCapacity	509		544		298	1067	594	
Flow Ratio	0.2		0.1		0.3	0.5	0.4	
v/c Ratio	0.62		0.42		0.53	0.90	0.68	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.5		4.4		2.5	21.3	7.2	
kB	0.4		0.7		0.3	0.7	0.8	
Q2	0.6		0.5		0.3	4.4	1.5	
Q Average	7.1		4.9		2.8	25.8	8.7	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	8.7		6.1		3.5	31.0	10.6	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	10.5		7.4		4.4	36.1	12.6	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.7		1.8	1.5	1.6	
BOQ	11.6		8.3		5.0	38.8	13.8	
QSRatio								
95th Percentile Output:								
fB%	1.8		2.0		2.2	1.6	1.8	
BOQ	13.1		9.7		6.1	41.4	15.5	
QSRatio								
98th Percentile Output:								
fB%	2.1		2.3		2.6	1.7	2.0	
BOQ	14.7		11.1		7.2	44.1	17.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	381						893			668		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.66	0.33	30.8	C	30.8	C

Westbound

Northbound

T 2134 3842 0.44 0.56 12.1 B 12.1 B

Southbound

T 1951 3512 0.37 0.56 11.7 B 11.7 B

Intersection Delay = 15.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	381						893			668		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	111						233			182		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	443						930			726		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	381						893			668		
PHF	0.86						0.96			0.92		
Adj flow	443						930			726		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	443						930			726		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.980						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2006						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	443	2006	# 0.22	0.33	669	0.66
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	930	3842	# 0.24	0.56	2134	0.44
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	726	3512	0.21	0.56	1951	0.37
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.46

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.66	0.33	25.7	1.000	669	0.50	5.1	0.0	30.8	C	30.8	C	
Westbound													
Northbound													
T	0.44	0.56	11.7	1.000	2134	0.50	0.4	0.0	12.1	B	12.1	B	
Southbound													
T	0.37	0.56	11.2	1.000	1951	0.50	0.5	0.0	11.7	B	11.7	B	

Intersection delay = 15.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	443						488		381	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2017		1844	
LnCapacity	669						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.66						0.44		0.37	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.567		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	9.5						7.2		5.3	
kB	0.9						0.7		1.1	
Q2	1.6						0.5		0.7	
Q Average	11.1						7.7		6.0	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	13.4						9.4		7.4	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	15.9						11.3		8.9	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	17.2						12.4		9.9	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	18.9						14.0		11.4	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.0		2.2	
BOQ	20.6						15.6		12.9	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						668	
Peak-Hour Factor, PHF						0.92	
Hourly Flow Rate, HFR						726	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							55
Peak Hour Factor, PHF							0.88
Hourly Flow Rate, HFR							62
Percent Heavy Vehicles							5
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage							/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								62
C(m) (vph)								675
v/c								0.09
95% queue length								0.30
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					668	
Peak-Hour Factor, PHF					0.92	
Peak-15 Minute Volume					182	
Hourly Flow Rate, HFR					726	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						55
Peak Hour Factor, PHF						0.88
Peak-15 Minute Volume						16
Hourly Flow Rate, HFR						62
Percent Heavy Vehicles						5
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								363
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		363
Potential Capacity		675
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		675
Probability of Queue free St.	1.00	0.91

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	433
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	433
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	433	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	433	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	483
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	483

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	708	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity	643	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.91	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						62
Movement Capacity (vph)						675
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						675
Volume						62
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								62
C(m) (vph)								675
v/c								0.09
95% queue length								0.30
Control Delay								10.9
LOS								B
Approach Delay							10.9	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	173	296	209	263	609	48	150	314	212	45	121	156
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	111	334	1.68	0.33	360.0	F		
TR	594	1782	0.83	0.33	36.7	D	125.5	F
Westbound								
L	125	362	2.19	0.34	588.8	F		
TR	1199	3482	0.69	0.34	28.3	C	167.7	F
Northbound								
LTR	953	3432	0.79	0.28	36.7	D	36.7	D
Southbound								
L	384	1728	0.14	0.22	28.8	C		
TR	357	1607	0.92	0.22	62.9	E	58.1	E

Intersection Delay = 109.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	173	296	209	263	609	48	150	314	212	45	121	156
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	80	56	68	195	15	42	87	59	13	36	46
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	186	491		274	828			752		54	330	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.222			0.000	
Prop RTs		0.352			0.057			0.314			0.564	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	173	296	209	263	609	48	150	314	212	45	121	156
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	186	318	173	274	781	47	167	349	236	54	144	186
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	186	491		274	828		752			54	330	
Prop LTs	1.000	0.000		1.000	0.000		0.222			0.000		
Prop RTs	0.352			0.057			0.314			0.564		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.947			0.991		0.953				0.915	
fLT	0.184	1.000		0.195	1.000		0.989			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	334	1782		362	3482		3432			1728	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	186	334	0.56	0.33	111	1.68
Prot							
Perm							
Thru	TR	491	1782	0.28	0.33	594	0.83
Right							
Westbound							
Prot							
Perm							
Left	L	274	362	# 0.76	0.34	125	2.19
Prot							
Perm							
Thru	TR	828	3482	0.24	0.34	1199	0.69
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	752	3432	# 0.22	0.28	953	0.79
Right							
Southbound							
Prot							
Perm							
Left	L	54	1728	0.03	0.22	384	0.14
Prot							
Perm							
Thru	TR	330	1607	# 0.21	0.22	357	0.92
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.18
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.40

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.68	0.33	30.0	1.000	111	0.50	330.0	0.0	360.0	F			
TR	0.83	0.33	27.6	1.000	594	0.50	9.1	0.0	36.7	D	125.5	F	
Westbound													
L	2.19	0.34	29.5	1.000	125	0.50	559.3	0.0	588.8	F			
TR	0.69	0.34	25.4	1.000	1199	0.50	3.0	0.0	28.3	C	167.7	F	
Northbound													
LTR	0.79	0.28	30.1	1.000	953	0.50	6.6	0.0	36.7	D	36.7	D	
Southbound													
L	0.14	0.22	28.1	1.000	384	0.50	0.7	0.0	28.8	C			
TR	0.92	0.22	34.3	1.000	357	0.50	28.6	0.0	62.9	E	58.1	E	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.222 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	13.80			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.460			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	828			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.057
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	18.7	0.0	360.0
TR	0.0	0.00	30.0	27.6	0.00	0.0	0.0	36.7
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	37.2	0.0	588.8
TR	0.0	0.00	29.5	25.4	0.00	0.0	0.0	28.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	30.1	0.00	0.0	0.0	36.7
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.1	0.00	0.0	0.0	28.8
TR	0.0	0.00	35.0	34.3	0.00	0.0	0.0	62.9
	0.0						0.0	

Intersection Delay	109.7	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	186	491		274	434		394			54	330	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	334	1782		362	1828		1802			1728	1607	
LnCapacity	111	594		125	629		500			384	357	
Flow Ratio	0.6	0.3		0.8	0.2		0.2			0.0	0.2	
v/c Ratio	1.68	0.83		2.19	0.69		0.79			0.14	0.92	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.7	11.3		6.8	9.3		9.1			1.1	8.1	
kB	0.2	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	9.8	2.3		19.1	1.6		2.2			0.1	3.0	
Q Average	14.4	13.5		25.9	10.9		11.3			1.2	11.1	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	17.4	16.3		31.1	13.2		13.7			1.5	13.5	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.4			1.6	1.4	
BOQ	20.4	19.2		36.3	15.6		16.2			1.9	15.9	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.5	1.6		1.6			1.9	1.6	
BOQ	22.1	20.8		38.9	17.0		17.6			2.2	17.3	
QSRatio												
95th Percentile Output:												
fB%	1.7	1.7		1.6	1.7		1.7			2.4	1.7	
BOQ	23.9	22.6		41.6	18.7		19.3			2.8	19.0	
QSRatio												
98th Percentile Output:												
fB%	1.8	1.8		1.7	1.9		1.9			2.9	1.9	
BOQ	25.7	24.4		44.3	20.4		21.0			3.4	20.7	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/16
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						592		
Peak-Hour Factor, PHF						0.93		
Hourly Flow Rate, HFR						636		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		173						
Peak Hour Factor, PHF		0.90						
Hourly Flow Rate, HFR		192						
Percent Heavy Vehicles		1						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			192						
C(m) (vph)			444						
v/c			0.43						
95% queue length			2.14						
Control Delay			19.1						
LOS			C						
Approach Delay				19.1					
Approach LOS				C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/16
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 592
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 159
 Hourly Flow Rate, HFR 636
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 173
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 48
 Hourly Flow Rate, HFR 192
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	636	
Potential Capacity	444	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	444	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 636
Potential Capacity 444
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 444

Results for Two-stage process:
a
y
C t 444

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	192					
Movement Capacity (vph)	444					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	444					
Volume	192					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			192					
C(m) (vph)			444					
v/c			0.43					
95% queue length			2.14					
Control Delay			19.1					
LOS			C					
Approach Delay				19.1				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	21	206	58	107	198	245	59	59	92	111	269	83
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.89	0.85	0.91	0.91	0.89	0.89	0.92	0.92
Flow Rate	138	189	225	377	132	103	265	236
% Heavy Veh	0	0	0	1	1	1	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	138	189	225	377	132	103	265	236
Left-Turn	23	0	117	0	66	0	120	0
Right-Turn	0	68	0	269	0	103	0	90
Prop. Left-Turns	0.2	0.0	0.5	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.4	0.0	0.7	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.1	-0.3	0.3	-0.5	0.3	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	138	189	225	377	132	103	265	236
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.12	0.17	0.20	0.34	0.12	0.09	0.24	0.21
hd, final value	7.92	7.58	7.67	6.93	8.37	7.42	7.83	7.34
x, final value	0.30	0.40	0.48	0.73	0.31	0.21	0.58	0.48
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.6	5.3	5.4	4.6	6.1	5.1	5.5	5.0

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	138	189	225	377	132	103	265	236
Service Time	5.6	5.3	5.4	4.6	6.1	5.1	5.5	5.0
Utilization, x	0.30	0.40	0.48	0.73	0.31	0.21	0.58	0.48
Dep. headway, hd	7.92	7.58	7.67	6.93	8.37	7.42	7.83	7.34
Capacity	388	439	461	512	382	353	450	479
Delay	14.04	15.21	17.24	25.84	14.73	12.11	20.64	16.64
LOS	B	C	C	D	B	B	C	C
Approach:								
Delay	14.72		22.63		13.58		18.76	
LOS	B		C		B		C	
Intersection Delay	18.63		Intersection		LOS C			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL TR			LTR		
Volume	79	147	286	229	512	24	255	262	112	25	815	162
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	824	3225	0.68	0.26	33.8	C	33.8	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	898	3512	1.09	0.26	90.1	F	90.1	F
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	93	289	2.91	0.32	920.3	F		
TR	598	1857	0.69	0.32	32.9	C	385.5	F

Southbound

LTR	976	3028	1.10	0.32	92.0	F	92.0	F
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 142.3 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	147	286	229	512	24	255	262	112	25	815	162
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	21	40	78	73	164	8	68	72	31	7	219	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		557			981		271	411			1077	
%InSharedLn												
Prop LTs		0.154			0.300		1.000	0.000			0.025	
Prop RTs		0.558			0.032			0.299			0.162	
Peds Bikes	0	0		0	0		0	0	0	0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	147	286	229	512	24	255	262	112	25	815	162
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	86	160	311	294	656	31	271	288	123	27	876	174
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	557			981			271 411			1077		
Prop LTs	0.154			0.300			1.000 0.000			0.025		
Prop RTs	0.558			0.032			0.299			0.162		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.916			0.995			0.955			0.976		
fLT	0.992			0.985			0.138 1.000			0.936		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3225			3512			289 1857			3028		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	557	3225	# 0.17	0.26	824	0.68
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	981	3512	# 0.28	0.26	898	1.09
Right							
Northbound							
Prot							
Perm							
Left	DefL	271	289	# 0.94	0.32	93	2.91
Prot							
Perm							
Thru	TR	411	1857	0.22	0.32	598	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1077	3028	0.36	0.32	976	1.10
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.39
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.67

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.68	0.26	30.1	1.000	824	0.50	3.7	0.0	33.8	C	33.8	C
Westbound												
LTR	1.09	0.26	33.5	1.000	898	0.50	56.6	0.0	90.1	F	90.1	F
Northbound												
DefL	2.91	0.32	30.5	1.000	93	0.50	889.8	0.0	920.3	F		
TR	0.69	0.32	26.6	1.000	598	0.50	6.3	0.0	32.9	C	385.5	F
Southbound												
LTR	1.10	0.32	30.5	1.000	976	0.50	61.5	0.0	92.0	F	92.0	F

Intersection delay = 142.3 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			271	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			1077	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.78	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			14.14	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			22.95	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			6.05	
n=Max(gq-gf)/2,0)			11.48	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.76	
EL2=Max((1-Ptho*n)/Plto, 1.0)			10.08	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			22.95	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.14	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.138	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	27
Proportion of LT in LT lane group, PLT	0.154 0.300 0.000 0.025
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	411
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.68
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.14
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	2.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.09
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06
EL1 (refer to Exhibit C16-3)	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.936

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				2.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.099
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				411
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.025
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.558	0.032	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	30.1	0.00	0.0	0.0	33.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	20.7	0.0	90.1
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	44.5	0.0	920.3
TR	0.0	0.00	30.5	26.6	0.00	0.0	0.0	32.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.5	0.00	25.2	0.0	92.0
	0.0						0.0	
Intersection Delay			142.3	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	292		515		271	411	565	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1693		1844		289	1857	1590	
LnCapacity	432		471		93	598	512	
Flow Ratio	0.2		0.3		0.9	0.2	0.4	
v/c Ratio	0.68		1.09		2.91	0.69	1.10	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.6		12.9		6.8	8.9	14.1	
kB	0.5		0.6		0.2	0.8	0.7	
Q2	1.0		9.5		22.6	1.6	11.2	
Q Average	7.6		22.3		29.4	10.6	25.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	9.3		26.8		35.2	12.8	30.4	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.4	1.4	1.4	
BOQ	11.1		31.4		41.1	15.2	35.4	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.5		1.5	1.6	1.5	
BOQ	12.2		33.6		44.1	16.5	38.0	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.6		1.6	1.7	1.6	
BOQ	13.8		36.0		47.0	18.2	40.6	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.7		1.7	1.9	1.7	
BOQ	15.4		38.4		50.0	19.9	43.2	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Sat Flw Rate EB-L = 2100
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2015 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	849	425			462	862				203		206
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left	P	
	Thru		P				Thru		
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Appr/ Lane Grp	Lane	Adj Sat	Ratios		Lane Group	Approach	
	Group	Flow Rate					
	Capacity	(s)	v/c	g/C	Delay	LOS	Delay LOS

L	895	1909	0.98	0.72	29.7	C		
T	1170	1646	0.38	0.71	5.6	A	21.6	C

T	460	1881	1.07	0.24	72.8	E	418.0	F
R	391	1599	2.27	0.24	608.6	F		

L	576	3239	0.38	0.18	34.6	C	20.8	C
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Intersection Delay = 195.5 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	849	425			462	862				203		206
% Heavy Veh	1	1			1	1				1		1
PHF	0.97	0.96			0.94	0.97				0.92		0.92
PK 15 Vol	219	111			123	222				55		56
Hi Ln Vol												
% Grade		0			0						0	
Ideal Sat	2100	1900			1900	1900				1900		1900
ParkExist												
NumPark			X									
			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0
Adj Flow	875	443			491	889				221		224
%InSharedLn												
Prop LTs	1.000	0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0		0			0		
Buses	0	0			0	0				0		0
%InProtPhase	50.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0				0.0		0.0
Arriv. Type	3	3			3	3				3		3
Unit Ext.	3.0	3.0			3.0	3.0				3.0		3.0
I Factor		0.508			0.176						1.000	
Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Ext of g	3.0	2.0			2.0	2.0				2.0		2.0
Ped Min g					24.6			3.2			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	849	425			462	862							203		206
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	875	443			491	889							221		224
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T	R		L	T	R
Adj flow	875	443			491	889			221				221		224
Prop LTs	1.000	0.000			0.000										
Prop RTs		0.000			0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T	R		L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0				2	0	1
fW	0.967	1.000			1.000	1.000			0.933				0.933		0.933
fHV	0.990	0.990			0.990	0.990			0.990				0.990		0.990
fG	1.000	1.000			1.000*1.000*				1.000				1.000		1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000		1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000		1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000		1.000
fLU	1.000	1.000			1.000	1.000			0.971				0.971		1.000
fRT		1.000			1.000	0.850									0.850
fLT	0.950	1.000			1.000				0.950				0.950		
Sec.	0.148														
fLpb	1.000	1.000			1.000				1.000				1.000		
fRpb		1.000			1.000	1.000									1.000
S	1909	1646			1881	1599			3239				3239		1492
Sec.	298														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

R 0.23 0.64 6.7 1.000 962 0.50 0.6 0.0 7.3 A

Intersection delay = 195.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			
Effective permitted green time for LT lane group, g(s)	27.0			
Opposing effective green time, go (s)	22.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	875			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	491			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLT/3600	21.88			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.27			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			
gq, (see Exhibit C16-4,5,6,7,8)	25.51			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	1.49			
n=Max(gq-gf)/2,0)	12.75			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.07			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	875			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	21.51			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	26.5			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.24			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	1.27			
XPerm	1.22			
XProt	0.78			
Case	3			
Queue at beginning of green arrow, Qa	7.54			
Queue at beginning of unsaturated green, Qu	5.23			
Residual queue, Qr	1.10			
Uniform Delay, d1	12.9			

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		12.9	0.00	0.0	0.0	29.7
T	0.0	0.00	13.0	5.1	0.00	0.0	0.0	5.6
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	34.0	34.0	0.00	7.7	0.0	72.8
R	0.0	0.00	34.0	34.0	0.00	124.5	0.0	608.6
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	32.6	0.00	0.0	0.0	34.6
	0.0						0.0	
R	0.0	0.00	16.0	6.7	0.00	0.0	0.0	7.3
Intersection Delay			195.5	sec/veh	Intersection LOS F			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	875	443		491	889				113	224
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1240	1646		1881	1599				1668	1492
LnCapacity	895	1170		460	391				296	962
Flow Ratio	0.7	0.3		0.3	0.6				0.1	0.2
v/c Ratio	0.98	0.38		1.07	2.27				0.38	0.23
Grn Ratio	0.72	0.71		0.24	0.24				0.18	0.64
I Factor		0.508		0.176						1.000
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00	1.00				1.00	1.00
Q1	10.3	4.4		12.3	22.2				2.5	2.3
kB	0.5	0.6		0.1	0.1				0.5	1.1
Q2	6.5	0.4		5.2	62.4				0.3	0.3
Q Average	16.9	4.8		17.5	84.7				2.8	2.7
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2				1.3	1.3
BOQ	20.3	5.9		21.1	102				3.5	3.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4				1.6	1.6
BOQ	23.8	7.2		24.7	119				4.4	4.2
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5				1.8	1.8
BOQ	25.6	8.1		26.5	127				5.0	4.8
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.6	1.6				2.2	2.2
BOQ	27.6	9.5		28.6	135				6.1	5.9
QSRatio										
98th Percentile Output:										
fB%	1.8	2.3		1.7	1.7				2.6	2.6
BOQ	29.5	10.9		30.6	144				7.1	6.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/17/13	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2015 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	585	45	0	0	45	56	0	0	1	81	0	1279
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	738	1476	0.83	0.50	29.0	C		
TR	1066	2132	0.04	0.50	11.6	B	27.8	C

LTR	1633	3266	0.06	0.50	11.7	B	11.7	B
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LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
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LT	546	1403	0.16	0.39	18.4	B	248.5	F
R	622	1599	1.52	0.39	269.6	F		

Intersection Delay = 154.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	585	45	0	0	45	56	0	0	1	81	0	1279
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	152	12	0	0	12	15	0	0	1	22	0	344
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	609	47			95			1			87	947
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.967			1.000			1.000			0.855	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	585	45	0	0	45	56	0	0	1	81	0	1279
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	609	47	0	0	49	46	0	0	1	87	0	947
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	609	47			95			1			87	947
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.692	1.000		1.000			1.000			0.746	
Sec.											
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	1476	2132		3266			3045			1403	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	609	1476	# 0.41	0.50	738	0.83
Prot							
Perm							
Thru	TR	47	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	95	3266	0.03	0.50	1633	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	87	1403	0.06	0.39	546	0.16
Right	R	947	1599	# 0.59	0.39	622	1.52

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.00$

Total lost time per cycle, $L = 10.00 \text{ sec}$

Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.13$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.83	0.50	19.2	1.000	738	0.50	9.9	0.0	29.0	C		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	27.8	C
Westbound												
LTR	0.06	0.50	11.6	1.000	1633	0.50	0.1	0.0	11.7	B	11.7	B
Northbound												
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B
Southbound												
LT	0.16	0.39	17.9	1.000	546	0.50	0.5	0.0	18.4	B	248.5	F

R 1.52 0.39 27.5 1.000 622 0.50 242.1 0.0 269.6 F

Intersection delay = 154.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	609			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	95			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	15.23			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.25			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.44			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.692			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	87
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	47	87	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.17
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.59	2.17	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.49
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	95	47	87	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.484	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	19.2	0.00	0.0	0.0	29.0
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.9	0.00	0.0	0.0	18.4
R	0.0	0.00	27.5	27.5	0.00	81.3	0.0	269.6
Intersection Delay			154.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	609	47			49				0				87	947	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1476	2132			1715				1599				1403	1599	
LnCapacity	738	1066			857				621				546	622	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.6	
v/c Ratio	0.83	0.04			0.06				0.00				0.16	1.52	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	13.0	0.6			0.6				0.0				1.4	23.7	
kB	0.9	1.2			1.0				0.8				0.6	0.7	
Q2	3.5	0.1			0.1				0.0				0.1	42.6	
Q Average	16.4	0.7			0.7				0.0				1.5	66.2	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	19.8	0.8			0.9				0.0				2.0	79.5	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	23.2	1.1			1.2				0.0				2.5	92.7	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	25.0	1.3			1.3				0.0				2.9	99.4	
QSRatio															
95th Percentile Output:															
fB%	1.6	2.5			2.5				2.6				2.3	1.6	
BOQ	26.9	1.6			1.7				0.0				3.6	106	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			3.0				3.2				2.8	1.7	
BOQ	28.9	2.0			2.1				0.0				4.3	113	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	374		34				5	279			731	776
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.77	0.32	27.1	C	26.3	C
R	497	1568	0.06	0.32	14.5	B		
Westbound								

Northbound

LT 1626 3148 0.20 0.52 8.1 A 8.1 A

Southbound

TR 1935 3746 0.87 0.52 15.8 B 15.8 B

Intersection Delay = 16.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	374		34				5	279		731	776	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	110		10				2	79		205	218	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	440		29					323			1693	
%InSharedLn												
Prop LTs								0.019			0.000	
Prop RTs			1.000					0.000			0.515	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	374		34				5	279		731	776	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	440		29				6	317		821	872	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	440		29					323			1693	
Prop LTs								0.019			0.000	
Prop RTs			1.000					0.000			0.515	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000	1.000	1.000	0.983	1.133	1.133	1.133
fHV	0.971	0.971	0.971	0.971	0.990	0.990	0.990	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	0.952	0.952	0.952	0.952
fRT		0.850		0.850	1.000	0.923	0.923	0.923
fLT	0.950				0.894	1.000	1.000	1.000
Sec.								
fLpb	1.000				1.000	1.000	1.000	1.000
fRpb		1.000		1.000	1.000	1.000	1.000	1.000
S	1811	1568			3148	3746	3746	3746
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	440	1811	# 0.24	0.32	573	0.77
Prot							
Perm							
Thru							
Right	R	29	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	323	3148	0.10	0.52	1626	0.20
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1693	3746	# 0.45	0.52	1935	0.87
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination															
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach				
	v/c	g/C							Delay	LOS	Delay	LOS			
Eastbound															
L	0.77	0.32	18.5	1.000	573	0.50	8.6	0.0	27.1	C	26.3	C			
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B					
Westbound															
Northbound															
LT	0.20	0.52	7.8	1.000	1626	0.50	0.3	0.0	8.1	A	8.1	A			
Southbound															
TR	0.87	0.52	12.8	1.000	1935	0.50	3.0	0.0	15.8	B	15.8	B			

Intersection delay = 16.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.019 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1693
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.82
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	23.31
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.69
n=Max(gq-gf)/2,0)	1.07
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	7.80
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.88
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.894

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			23.31	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.752	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1693	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.019	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)				31.0
Conflicting pedestrian volume, Vped (p/h)				0
Conflicting bicycle volume, Vbic (bicycles/h)				0
Vpedg				0
OCCpedg				0.000
Effective green, g (s)				31.0
Vbicg				0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.515
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	18.5	0.00	0.0	0.0	27.1
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.8	0.00	0.0	0.0	8.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	12.8	0.00	0.0	0.0	15.8
	0.0						0.0	
Intersection Delay			16.8	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	440	29				169		889	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1653		1967	
LnCapacity	573	497				853		1016	
Flow Ratio	0.2	0.0				0.1		0.5	
v/c Ratio	0.77	0.06				0.20		0.88	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	6.6	0.3				1.5		13.1	
kB	0.5	0.5				0.8		0.4	
Q2	1.6	0.0				0.2		2.6	
Q Average	8.2	0.4				1.7		15.6	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	10.0	0.5				2.2		18.8	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	11.9	0.6				2.8		22.1	
QSRatio									
90th Percentile Output:									
fB%	1.6	2.0				1.9		1.5	
BOQ	13.1	0.7				3.2		23.8	
QSRatio									
95th Percentile Output:									
fB%	1.8	2.5				2.3		1.6	
BOQ	14.7	0.9				3.9		25.7	
QSRatio									
98th Percentile Output:									
fB%	2.0	3.1				2.8		1.8	
BOQ	16.3	1.1				4.7		27.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		732	2		5			27	775	1
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	606	1454	1.00	0.42	52.3	D		
LT	582	1398	0.35	0.42	13.5	B	42.5	D

Northbound

L	177	424	0.03	0.42	10.7	B	10.7	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2040	4896	0.44	0.42	13.2	B	13.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 26.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		732	2		5			27	775	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		201	1		2			8	218	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			603	203		6			902		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.990		1.000				0.033	
Prop RTs	0.000			0.000						0.001		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		732	2		5			27	775	1
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	4	0		804	2		6			30	871	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			603	203		6			902		
Prop LTs	0.000			1.000 0.990			1.000			0.033		
Prop RTs	0.000			0.000						0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.726		0.239		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1454 1398		424		4896	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	603	1454	# 0.41	0.42	606	1.00
Prot							
Perm							
Thru	LT	203	1398	0.15	0.42	582	0.35
Right							
Northbound							
Prot							
Perm							
Left	L	6	424	0.01	0.42	177	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	902	4896	# 0.18	0.42	2040	0.44
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	1.00	0.42	17.4	1.000	606	0.50	34.8	0.0	52.3	D			
LT	0.35	0.42	11.9	1.000	582	0.50	1.6	0.0	13.5	B	42.5	D	
Northbound													
L	0.03	0.42	10.4	1.000	177	0.50	0.3	0.0	10.7	B	10.7	B	
Southbound													
LTR	0.44	0.42	12.5	1.000	2040	0.50	0.7	0.0	13.2	B	13.2	B	

Intersection delay = 26.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		603	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		4	902	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		10.05	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	5.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.25	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	19.75	
n=Max(gq-gf)/2,0)		0.00	2.63	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	3.30	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.56	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	5.25	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.239	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	201		
Proportion of LT in LT lane group, PLT	0.000	0.990	0.033
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.35		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L	LTR		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	4		603	203	6	331		
So	1900		1900	1900	1900	1900		
No.Lanes	0	1	0	1	0	0	3	
SL	1881		1454	1398	424	1797		
LnCapacity	784		606	582	177	748		
Flow Ratio	0.0		0.4	0.1	0.0	0.2		
v/c Ratio	0.01		1.00	0.35	0.03	0.44		
Grn Ratio	0.42		0.42	0.42	0.42	0.42		
I Factor	1.000		0.971		0.951		1.000	
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	0.0		10.0	2.3	0.1	3.9		
kB	0.7		0.6	0.6	0.2	0.7		
Q2	0.0		6.5	0.3	0.0	0.6		
Q Average	0.0		16.5	2.6	0.1	4.5		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3	1.2		
BOQ	0.1		19.8	3.3	0.1	5.6		
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7	1.5		
BOQ	0.1		23.3	4.1	0.1	6.8		
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0	1.7		
BOQ	0.1		25.0	4.7	0.1	7.7		
QSRatio								
95th Percentile Output:								
fB%	2.6		1.6	2.2	2.6	2.0		
BOQ	0.1		27.0	5.7	0.2	9.0		
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2	2.3		
BOQ	0.1		28.9	6.8	0.2	10.4		
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	28
Peak-Hour Factor, PHF	0.69
Hourly Flow Rate, HFR	40
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	648
Peak Hour Factor, PHF	0.88
Hourly Flow Rate, HFR	736
Percent Heavy Vehicles	0
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	736
C(m) (vph)	1037
v/c	0.71
95% queue length	6.29
Control Delay	16.5
LOS	C
Approach Delay	16.5
Approach LOS	C

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		28				
Peak-Hour Factor, PHF		0.69				
Peak-15 Minute Volume		10				
Hourly Flow Rate, HFR		40				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			648			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			184			
Hourly Flow Rate, HFR			736			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					40			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process								
	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	40	
Potential Capacity	1037	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1037	
Probability of Queue free St.	0.29	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.29
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

```

Result for 2 stage process:
a
y
C t
Probability of Queue free St.      1.00      1.00

```

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.29
Movement Capacity		

```
Results for Two-stage process:
a
y
C t
```

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)			736			
Movement Capacity (vph)			1037			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1037			
Volume			736			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					736			
C(m) (vph)					1037			
v/c					0.71			
95% queue length					6.29			
Control Delay					16.5			
LOS					C			
Approach Delay				16.5				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	75	34	287	58	0	0	0	0	17	116	22
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.75		0.85				0.89 0.89	
Flow Rate	145		405				84 89	
% Heavy Veh	2		4				0 0	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	145		405				84	89
Left-Turn	0		337				19	0
Right-Turn	45		0				0	24
Prop. Left-Turns	0.0		0.8				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/17/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2015 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	25	66	0	0	293	23	51	103	135	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	121		371		106		196	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	121		371		106	196		
Left-Turn	33		0		53	0		
Right-Turn	0		27		0	142		
Prop. Left-Turns	0.3		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	-0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	121		371		106	196		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.11		0.33		0.09	0.17		
hd, final value	5.19		4.77		5.24	4.70		
x, final value	0.17		0.49		0.15	0.26		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.2		2.8		3.2	2.7		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	121		371		106	196		
Service Time	3.2		2.8		3.2	2.7		
Utilization, x	0.17		0.49		0.15	0.26		
Dep. headway, hd	5.19		4.77		5.24	4.70		
Capacity	371		621		356	446		
Delay	9.29		12.30		9.20	9.32		
LOS	A		B		A	A		
Approach:								
Delay		9.29		12.30		9.28		
LOS		A		B		A		
Intersection Delay	10.69							
			Intersection	LOS	B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	211	286	178	0	61	15	672	63	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	558	1595	1.19	0.35	120.4	F	101.1	F
R	560	1599	0.27	0.35	15.1	B		

Westbound

LTR	557	1591	0.16	0.35	14.1	B	14.1	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2266	4689	0.35	0.48	10.1	B	10.1	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 53.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	211	286	178	0	61	15	672	63	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	70	95	59	0	18	5	181	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		662	149		91			794				
%InSharedLn												
Prop LTs		0.424			0.000			0.911				
Prop RTs		0.000	1.000		0.198			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	211	286	178	0	61	15	672	63	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	281	381	149	0	73	18	723	68	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	662 149			91			794					
Prop LTs	0.424			0.000			0.911					
Prop RTs	0.000 1.000			0.198			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.973			0.999	
fLT	0.821			1.000			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1595	1599		1591			4689	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Southbound

Intersection delay = 53.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	281	0	
Proportion of LT in LT lane group, PLT	0.424	0.000	0.911
Proportion of LT in opposing flow, PLTo	0.00	0.42	
Adjusted opposing flow rate, Vo (veh/h)	91	662	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.68	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.52	11.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.50	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.50	
n=Max(gq-gf)/2,0)	0.00	7.25	
PTHo=1-PLTo	1.00	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.00	
EL1 (refer to Exhibit C16-3)	1.52	2.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.31	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	14.50	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.31	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.821	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	14.50		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.690		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	91	662	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.424	0.000	0.911	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.198	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	26.0	0.0	120.4
R	0.0	0.00	19.5	14.0	0.00	0.0	0.0	15.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.4	0.00	0.0	0.0	14.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.6	0.00	0.0	0.0	10.1
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	

Intersection Delay	53.8	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	662	149	91		291			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1595	1599	1591		1721			
LnCapacity	558	560	557		831			
Flow Ratio	0.4	0.1	0.1		0.2			
v/c Ratio	1.19	0.27	0.16		0.35			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.997		0.993		0.967			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	11.0	1.8	1.0		3.0			
kB	0.6	0.6	0.6		0.7			
Q2	16.0	0.2	0.1		0.4			
Q Average	27.0	2.0	1.2		3.4			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.3			
BOQ	32.4	2.5	1.5		4.3			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.6			
BOQ	37.8	3.2	1.9		5.3			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.8	1.9		1.8			
BOQ	40.5	3.6	2.2		6.0			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.3	2.4		2.1			
BOQ	43.3	4.5	2.8		7.2			
QSRatio								
98th Percentile Output:								
fB%	1.7	2.7	2.9		2.5			
BOQ	46.1	5.4	3.3		8.4			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	235		54				17	388		367	59	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	466	1747	0.67	0.27	26.8	C	26.8	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1111	1961	0.40	0.57	8.3	A	8.3	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1185	2092	0.39	0.57	8.2	A	8.2	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 13.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	235		54				17	388		367	59	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
PK 15 Vol	64		15				5	105		101	16	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		314						440			468	
%InSharedLn												
Prop LTs		0.812						0.041			0.000	
Prop RTs		0.188						0.000			0.139	
Peds Bikes	0			0						0		0
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.937						0.937			0.937	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	235		54				17	388		367	59	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
Adj flow	255		59				18	422		403	65	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		314						440			468	
Prop LTs		0.812						0.041			0.000	
Prop RTs		0.188						0.000			0.139	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.975						1.000			0.981		
fLT	0.961						0.977			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1747						1961			2092		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	314	1747	# 0.18	0.27	466	0.67
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	440	1961	# 0.22	0.57	1111	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	468	2092	0.22	0.57	1185	0.39
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.48

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.67	0.27	19.7	1.000	466	0.50	7.1	0.0	26.8	C	26.8	C
Westbound												
Northbound												
LT	0.40	0.57	7.3	1.000	1111	0.50	1.0	0.0	8.3	A	8.3	A
Southbound												
TR	0.39	0.57	7.3	1.000	1185	0.50	0.9	0.0	8.2	A	8.2	A

Intersection delay = 13.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.812	0.041	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		468	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.80	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		4.74	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.23	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.977	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.74	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.139	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			468	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.041	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.139
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.7	0.00	0.0	0.0	26.8
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.2
	0.0						0.0	
Intersection Delay			13.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	314						440			468		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1747						1961			2092		
LnCapacity	466						1111			1185		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.67						0.40			0.39		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.937						0.937			0.937		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.7						4.1			4.4		
kB	0.5						0.9			0.9		
Q2	0.9						0.6			0.6		
Q Average	5.6						4.7			4.9		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.9						5.8			6.1		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	8.4						7.1			7.5		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.7			1.7		
BOQ	9.3						7.9			8.3		
QSRatio												
95th Percentile Output:												
fB%	1.9						2.0			2.0		
BOQ	10.8						9.3			9.7		
QSRatio												
98th Percentile Output:												
fB%	2.2						2.3			2.3		
BOQ	12.3						10.7			11.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	138		65				42	519		371	274	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								20	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	575	1726	0.47	0.33	18.4	B	18.4	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	839	1678	0.73	0.50	16.5	B	16.5	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	1008	2015	0.68	0.50	14.8	B	14.8	B
----	------	------	------	------	------	---	------	---

Intersection Delay = 16.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	138		65				42	519		371	274	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	46		22				11	141		102	75	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		271						610			687	
%InSharedLn												
Prop LTs		0.679						0.075			0.000	
Prop RTs	0.321						0.000			0.406		
Peds Bikes	0	0		0						0	0	
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	138		65				42	519		371	274	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	184		87				46	564		408	279	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		271						610			687	
Prop LTs		0.679						0.075			0.000	
Prop RTs		0.321						0.000			0.406	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.957						1.000			0.945		
fLT	0.967						0.899			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1726						1678			2015		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	271	1726	# 0.16	0.33	575	0.47
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	610	1678	# 0.36	0.50	839	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	687	2015	0.34	0.50	1008	0.68
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.52

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.47	0.33	15.8	1.000	575	0.50	2.6	0.0	18.4	B	18.4	B
Westbound												
Northbound												
LT	0.73	0.50	11.8	1.000	839	0.50	4.7	0.0	16.5	B	16.5	B
Southbound												
TR	0.68	0.50	11.4	1.000	1008	0.50	3.4	0.0	14.8	B	14.8	B

Intersection delay = 16.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		46	
Proportion of LT in LT lane group, PLT	0.679	0.075	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		687	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.77	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.45	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		10.18	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		19.82	
n=Max(gq-gf)/2,0)		0.35	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.08	
EL1 (refer to Exhibit C16-3)		2.76	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.90	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.899	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			10.18	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.339	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		687	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.679		0.075	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.321	0.406
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	15.8	0.00	0.0	0.0	18.4
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.8	0.00	0.0	0.0	16.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	11.4	0.00	0.0	0.0	14.8
	0.0						0.0	
Intersection Delay			16.0	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	271						610			687		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1726						1678			2015		
LnCapacity	575						839			1008		
Flow Ratio	0.2						0.4			0.3		
v/c Ratio	0.47						0.73			0.68		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.6						8.0			8.7		
kB	0.5						0.6			0.8		
Q2	0.5						1.6			1.6		
Q Average	4.1						9.6			10.3		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.0						11.7			12.5		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.2						13.9			14.8		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.0						15.1			16.1		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.7			1.7		
BOQ	8.3						16.8			17.8		
QSRatio												
98th Percentile Output:												
fB%	2.4						1.9			1.9		
BOQ	9.6						18.5			19.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		160	285	596	168	126	218		404		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.12	0.13	23.7	C	76.9	E
R	220	1652	1.02	0.13	83.3	F		
Westbound								
LTR	1338	4723	0.90	0.28	26.0	C	26.0	C
Northbound								
L	148	443	0.93	0.33	72.7	E		
T	621	1863	0.38	0.33	16.9	B	37.4	D
Southbound								
TR	707	2120	0.66	0.33	20.7	C	20.7	C

Intersection Delay = 32.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		160	285	596	168	126	218		404	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		56	82	171	48	34	59		112	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		225		1206		137	237			468	
%InSharedLn												
Prop LTs					0.272		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000		0.041		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		160	285	596	168	126	218		404	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		225	328	685	193	137	237		449	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	27		225		1206		137	237			468	
Prop LTs					0.272		1.000	0.000			0.000	
Prop RTs			1.000		0.160			0.000			0.041	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.980	0.980	0.990	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	1.000	1.000	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.976			1.000	0.995	
fLT	0.950		0.987		0.238	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4723		443	1863	2120	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.13	222	0.12
Prot							
Perm							
Thru							
Right	R	225	1652	# 0.14	0.13	220	1.02
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1206	4723	# 0.26	0.28	1338	0.90
Right							
Northbound							
Prot							
Perm							
Left	L	137	443	# 0.31	0.33	148	0.93
Prot							
Perm							
Thru	T	237	1863	0.13	0.33	621	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	468	2120	0.22	0.33	707	0.66
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.70
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.93

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.12	0.13	22.9	1.000	222	0.50	0.8	0.0	23.7	C	76.9	E	
R	1.02	0.13	26.0	1.000	220	0.50	57.3	0.0	83.3	F			
Westbound													
LTR	0.90	0.28	20.7	1.000	1338	0.50	5.3	0.0	26.0	C	26.0	C	
Northbound													
L	0.93	0.33	19.3	1.000	148	0.50	53.5	0.0	72.7	E	37.4	D	
T	0.38	0.33	15.3	1.000	621	0.50	1.6	0.0	16.9	B			
Southbound													
TR	0.66	0.33	17.1	1.000	707	0.50	3.6	0.0	20.7	C	20.7	C	

Intersection delay = 32.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			137	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			468	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.28	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.80	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			10.38	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.62	
n=Max(gq-gf)/2,0)			5.19	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.02	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.238	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.272 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.38	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.519	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			468	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)		17.0		20.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		17.0		20.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.160	0.041
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.7
	0.0						0.0	
R	0.0	0.00	26.0	26.0	0.00	1.2	0.0	83.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.7	0.00	0.0	0.0	26.0
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	19.3	0.00	0.0	0.0	72.7
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	17.1	0.00	0.0	0.0	20.7
	0.0						0.0	
Intersection Delay			32.4	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	27	225		442		137	237		468
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1733		443	1863		2120
LnCapacity	222	220		491		148	621		707
Flow Ratio	0.0	0.1		0.3		0.3	0.1		0.2
v/c Ratio	0.12	1.02		0.90		0.93	0.38		0.66
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.717		0.483			0.917		0.747
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.4	3.8		7.1		2.2	3.0		6.7
kB	0.2	0.2		0.3		0.2	0.6		0.5
Q2	0.0	2.8		1.8		1.3	0.3		1.0
Q Average	0.4	6.5		8.9		3.5	3.4		7.6
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.2	1.3		1.2
BOQ	0.6	8.0		10.8		4.4	4.2		9.3
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.5	1.6		1.5
BOQ	0.7	9.7		12.8		5.4	5.2		11.2
QSRatio									
90th Percentile Output:									
fB%	2.0	1.6		1.6		1.7	1.8		1.6
BOQ	0.8	10.7		14.0		6.1	5.9		12.3
QSRatio									
95th Percentile Output:									
fB%	2.5	1.9		1.8		2.1	2.1		1.8
BOQ	1.1	12.2		15.7		7.4	7.1		13.9
QSRatio									
98th Percentile Output:									
fB%	3.1	2.1		2.0		2.4	2.5		2.0
BOQ	1.3	13.8		17.3		8.6	8.3		15.5
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	30	32	5				3	314	143	305	498	46
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.19 0.28 17.2 B 17.2 B

Westbound

Northbound

LTR 971 1766 0.51 0.55 10.2 B 10.2 B

Southbound

L 475 864 0.71 0.55 15.8 B
 TR 1025 1863 0.58 0.55 10.4 B 12.4 B

Intersection Delay = 12.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	30	32	5				3	314	143	305	498	46
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	11	2				1	85	39	85	138	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		88						499		339	592	
%InSharedLn												
Prop LTs		0.443						0.006		1.000	0.000	
Prop RTs		0.080						0.311			0.066	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	30	32	5				3	314	143	305	498	46
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	39	42	7				3	341	155	339	553	39
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	88						499			339	592	
Prop LTs	0.443						0.006			1.000	0.000	
Prop RTs	0.080						0.311			0.066		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.990	0.990	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							1.000			1.000	1.000	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.989							0.958				0.990	
fLT	0.978							0.998			0.459	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1630							1766			864	1863	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1630	# 0.05	0.28	462	0.19
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	499	1766	0.28	0.55	971	0.51
Right							
Southbound							
Prot							
Perm							
Left	L	339	864	# 0.39	0.55	475	0.71
Prot							
Perm							
Thru	TR	592	1863	0.32	0.55	1025	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.19	0.28	16.3	1.000	462	0.50	0.9	0.0	17.2	B	17.2	B
Westbound												
Northbound												
LTR	0.51	0.55	8.5	1.000	971	0.50	1.7	0.0	10.2	B	10.2	B
Southbound												
L	0.71	0.55	10.0	1.000	475	0.50	5.8	0.0	15.8	B		
TR	0.58	0.55	8.9	1.000	1025	0.50	1.5	0.0	10.4	B	12.4	B

Intersection delay = 12.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				339
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				499
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.65
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				8.32
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				5.64
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.36
n=Max(gq-gf)/2,0)				2.82
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.08
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.81
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				5.64
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.46
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.459

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.443
Proportion of LT in opposing flow, PLTo	0.006 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	592
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.87
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	7.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.52
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.12	5.64
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.216	0.171
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			592	499
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.006	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.080	0.311	0.066
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.5	0.00	0.0	0.0	10.2
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	10.0	0.00	0.0	0.0	15.8
TR	0.0	0.00	13.5	8.9	0.00	0.0	0.0	10.4
	0.0						0.0	

Intersection Delay	12.0	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR		L	TR	
Init Queue		0.0						0.0		0.0	0.0	
Flow Rate		88						499		339	592	
So		1900						1900		1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1630						1766		864	1863	
LnCapacity		462						971		475	1025	
Flow Ratio		0.1						0.3		0.4	0.3	
v/c Ratio		0.19						0.51		0.71	0.58	
Grn Ratio		0.28						0.55		0.55	0.55	
I Factor		1.000						0.899			0.644	
AT or PVG		3						3		3	3	
Pltn Ratio		1.00						1.00		1.00	1.00	
PF2		1.00						1.00		1.00	1.00	
Q1		1.1						5.2		4.2	6.5	
kB		0.5						0.8		0.3	0.6	
Q2		0.1						0.8		0.8	0.8	
Q Average		1.2						6.0		5.0	7.3	
Q Spacing		25.0						25.0		25.0	25.0	
Q Storage		0						0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2		1.2	1.2	
BOQ		1.6						7.4		6.1	8.9	
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5		1.5	1.5	
BOQ		2.0						9.0		7.5	10.7	
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7		1.7	1.6	
BOQ		2.3						9.9		8.4	11.7	
QSRatio												
95th Percentile Output:												
fB%		2.4						1.9		2.0	1.8	
BOQ		2.9						11.4		9.8	13.3	
QSRatio												
98th Percentile Output:												
fB%		2.9						2.2		2.3	2.1	
BOQ		3.5						12.9		11.2	14.9	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/17/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	7	18	284	18	102	12	309	234	83	406	7
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					40.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 628 1414 0.06 0.44 14.4 B 14.4 B

Westbound

L 580 1306 0.54 0.44 21.6 C
 T 808 1818 0.02 0.44 14.1 B 19.8 B
 R 601 1352 0.19 0.44 15.8 B

Northbound

LTR 741 1668 0.81 0.44 26.9 C 26.9 C

Southbound

LTR 626 1408 0.88 0.44 31.9 C 31.9 C

Intersection Delay = 26.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	7	18	284	18	102	12	309	234	83	406	7
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	79	5	28	3	84	64	23	113	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		37		316	20	113		603			551	
%InSharedLn												
Prop LTs		0.216		1.000	0.000			0.022			0.167	
Prop RTs		0.568			0.000	1.000		0.421			0.015	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	7	18	284	18	102	12	309	234	83	406	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	8	8	21	316	20	113	13	336	254	92	451	8
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	37			316	20	113	603			551		
Prop LTs	0.216			1.000	0.000		0.022			0.167		
Prop RTs	0.568			0.000 1.000			0.421			0.015		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.990	0.990	0.990	1.000		0.990		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	1.000		1.000	1.000	1.000	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.923		1.000 0.850			0.943		0.998		
fLT	0.970		0.733	1.000		0.986		0.753		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.997		
fRpb	0.968		1.000 1.000			0.976		1.000		
S	1414		1306	1818	1352	1668		1408		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	37	1414	0.03	0.44	628	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	316	1306	# 0.24	0.44	580	0.54
Prot							
Perm							
Thru	T	20	1818	0.01	0.44	808	0.02
Right	R	113	1352	0.08	0.44	601	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1668	0.36	0.44	741	0.81
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	551	1408	# 0.39	0.44	626	0.88
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	628	0.50	0.2	0.0	14.4	B	14.4	B
Westbound												
L	0.54	0.44	18.3	1.000	580	0.50	3.2	0.0	21.6	C		
T	0.02	0.44	14.0	1.000	808	0.50	0.1	0.0	14.1	B	19.8	B
R	0.19	0.44	15.2	1.000	601	0.50	0.6	0.0	15.8	B		
Northbound												
LTR	0.81	0.44	21.8	1.000	741	0.50	5.2	0.0	26.9	C	26.9	C
Southbound												
LTR	0.88	0.44	22.8	1.000	626	0.50	9.0	0.0	31.9	C	31.9	C

Intersection delay = 26.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		316		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.22		
Adjusted opposing flow rate, Vo (veh/h)		37		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.90		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.78		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.36		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.733		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	8	13	92
Proportion of LT in LT lane group, PLT	0.216	0.000	0.022
Proportion of LT in opposing flow, PLTo	0.00	0.17	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	551	603
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.20	0.33	2.30
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	13.77	15.07
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	25.3	21.2	4.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.55	15.94
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.71	18.83	24.06
n=Max(gq-gf)/2,0)	0.00	0.00	5.79
PTHo=1-PLTo	1.00	0.83	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.22	0.02	0.17
EL1 (refer to Exhibit C16-3)	1.40	2.42	2.54
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.50
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	11.58
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.99	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.970	0.986	0.753

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.55	15.94
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.364	0.399
OCCpedu	0.000	0.056	0.000	0.045
Opposing flow rate, Vo (veh/h)	20	37	551	603
OCCr	0.000	0.053	0.000	0.019
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.981
Proportion of left turns, PLT	0.216	1.000	0.022	0.167
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.997
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.568	1.000	0.421	0.015
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.968	1.000	0.976	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	14.3	0.00	0.0	0.0 0.0 0.0	14.4
Westbound								
L	0.0	0.00	25.0	18.3	0.00	0.0	0.0	21.6
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.8
Northbound								
LTR	0.0 0.0 0.0	0.00	25.0	21.8	0.00	0.0	0.0 0.0 0.0	26.9
Southbound								
LTR	0.0 0.0 0.0	0.00	25.0	22.8	0.00	0.0	0.0 0.0 0.0	31.9
Intersection Delay			26.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		37	316	20	113		603		551
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1 0	1	1	1	0	1 0	0	1 0
SL		1414	1306	1818	1352		1668		1408
LnCapacity		628	580	808	601		741		626
Flow Ratio		0.0	0.2	0.0	0.1		0.4		0.4
v/c Ratio		0.06	0.54	0.02	0.19		0.81		0.88
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.887			0.516		0.500
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.5	5.8	0.3	1.7		13.1		12.6
kB		0.8	0.7	0.9	0.7		0.5		0.4
Q2		0.1	0.8	0.0	0.2		1.9		2.4
Q Average		0.6	6.6	0.3	1.9		15.0		15.0
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.7	8.1	0.4	2.4		18.1		18.0
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.0	9.8	0.5	3.0		21.2		21.2
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.1	10.8	0.6	3.5		22.9		22.8
QSRatio									
95th Percentile Output:									
fB%		2.5	1.9	2.5	2.3		1.6		1.7
BOQ		1.4	12.3	0.8	4.3		24.8		24.7
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.8		1.8
BOQ		1.8	13.9	0.9	5.1		26.6		26.6
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/17/13

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	193		232	195	192		147		161			
Lane Width	16.0			16.0			11.0					
RTOR Vol			56						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	980	1959	0.48	0.50	16.4	B	16.4	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	488	976	0.89	0.50	41.3	D	41.3	D
----	-----	-----	------	------	------	---	------	---

Northbound

LR	562	1445	0.64	0.39	27.8	C	27.8	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 28.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/17/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		193	232	195	192		147		161			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		62	74	55	54		43		47			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		473			435			362				
%InSharedLn												
Prop LTs		0.000			0.503			0.478				
Prop RTs		0.478			0.000			0.522				
Peds Bikes		0						0		0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		193	232	195	192		147		161			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		247	226	219	216		173		189			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		473			435			362				
Prop LTs		0.000			0.503			0.478				
Prop RTs		0.478			0.000			0.522				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.935			1.000			0.930					
fLT	1.000			0.471			0.977					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1959			976			1445					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.48	0.50	14.8	1.000	980	0.50	1.6	0.0	16.4	B	16.4	B
Westbound												
LT	0.89	0.50	20.3	1.000	488	0.50	21.0	0.0	41.3	D	41.3	D
Northbound												
LR	0.64	0.39	22.4	1.000	562	0.50	5.3	0.0	27.8	C	27.8	C
Southbound												

Intersection delay = 28.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	219		
Proportion of LT in LT lane group, PLT	0.000	0.503	0.478
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	473		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.47		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.82		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	10.56		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.44		
n=Max(gq-gf)/2,0)	5.28		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.50		
EL1 (refer to Exhibit C16-3)	2.24		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.47		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.471		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.8	0.00	0.0	0.0	16.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	20.3	0.00	0.0	0.0	41.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	22.4	0.00	0.0	0.0	27.8
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			28.2	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		473			435			362				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1959			976			1445				
LnCapacity		980			488			562				
Flow Ratio		0.2			0.4			0.3				
v/c Ratio		0.48			0.89			0.64				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		7.8			9.8			7.4				
kB		1.0			0.7			0.7				
Q2		1.0			3.6			1.3				
Q Average		8.8			13.4			8.6				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		10.7			16.2			10.5				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.5				
BOQ		12.7			19.1			12.5				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.6				
BOQ		13.9			20.6			13.7				
QSRatio												
95th Percentile Output:												
fB%		1.8			1.7			1.8				
BOQ		15.5			22.4			15.3				
QSRatio												
98th Percentile Output:												
fB%		2.0			1.8			2.0				
BOQ		17.2			24.2			17.0				
QSRatio												

ERROR MESSAGES

No errors to report.

With-Action

2020

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	9	8	8	46	10	28	27	186	42	29	200	39
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 179 1533 0.17 0.12 26.0 C 26.0 C

Westbound

LTR 477 1908 0.18 0.25 18.5 B 18.5 B

Northbound

LTR 622 1623 0.50 0.38 16.9 B 16.9 B

Southbound

LTR 662 1728 0.49 0.38 16.6 B 16.6 B

Intersection Delay = 17.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	8	8	46	10	28	27	186	42	29	200	39
% Heavy Veh	32	32	32	5	5	5	20	20	20	13	13	13
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	3	3	3	12	3	7	8	56	13	9	60	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		31			88			308			323	
%InSharedLn												
Prop LTs		0.355			0.545			0.107			0.108	
Prop RTs		0.323			0.330			0.166			0.146	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			4			4	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	8	8	46	10	28	27	186	42	29	200	39
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	11	10	10	48	11	29	33	224	51	35	241	47
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	31			88			308			323		
Prop LTs	0.355			0.545			0.107			0.108		
Prop RTs	0.323			0.330			0.166			0.146		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.758			0.952			0.833			0.885		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.984			0.984		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.956			0.956			0.978			0.980		
fLT	0.983			0.973			0.940			0.940		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1533			1908			1623			1728		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	31	1533	# 0.02	0.12	179	0.17
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1908	# 0.05	0.25	477	0.18
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	308	1623	# 0.19	0.38	622	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	323	1728	0.19	0.38	662	0.49
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.26

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.34

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.17	0.12	23.9	1.000	179	0.50	2.1	0.0	26.0	C	26.0	C
Westbound												
LTR	0.18	0.25	17.7	1.000	477	0.50	0.9	0.0	18.5	B	18.5	B
Northbound												
LTR	0.50	0.38	14.1	1.000	622	0.50	2.8	0.0	16.9	B	16.9	B
Southbound												
LTR	0.49	0.38	14.0	1.000	662	0.50	2.6	0.0	16.6	B	16.6	B

Intersection delay = 17.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	35
Proportion of LT in LT lane group, PLT	0.355	0.545	0.107	0.108
Proportion of LT in opposing flow, PLTo			0.11	0.11
Adjusted opposing flow rate, Vo (veh/h)			323	308
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.38	5.13
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			5.67	5.29
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.26	15.54
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.89	0.89
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.11	0.11
EL1 (refer to Exhibit C16-3)			1.93	1.90
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.94	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.940	0.940

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				5.29
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.230
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				308
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.108
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.323	0.166
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	23.9	0.00	0.0	0.0	26.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.7	0.00	0.0	0.0	18.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.1	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.0	0.00	0.0	0.0	16.6
	0.0						0.0	
Intersection Delay			17.3	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	31		88		308		323	
So	1900		1900		1900		1900	
No.Lanes	1	0	1	0	1	0	1	0
SL	1533		1908		1623		1728	
LnCapacity	179		477		622		662	
Flow Ratio	0.0		0.0		0.2		0.2	
v/c Ratio	0.17		0.18		0.50		0.49	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	0.5		1.2		3.9		4.1	
kB	0.3		0.5		0.6		0.6	
Q2	0.1		0.1		0.6		0.6	
Q Average	0.5		1.3		4.5		4.7	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	0.7		1.6		5.6		5.8	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.6		1.5		1.5	
BOQ	0.9		2.1		6.9		7.1	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.9		1.7		1.7	
BOQ	1.0		2.4		7.7		8.0	
QSRatio								
95th Percentile Output:								
fB%	2.5		2.4		2.0		2.0	
BOQ	1.3		3.0		9.0		9.3	
QSRatio								
98th Percentile Output:								
fB%	3.1		2.9		2.3		2.3	
BOQ	1.6		3.6		10.4		10.7	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	 	4 L	5 T	6 R
Volume			216	89		45	208	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			260	107		54	250	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	 	10 L	11 T	12 R
Volume		150		39				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		217		56				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		54			273					
C(m) (vph)		1144			445					
v/c		0.05			0.61					
95% queue length		0.15			4.01					
Control Delay		8.3			25.1					
LOS		A			D					
Approach Delay					25.1					
Approach LOS					D					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		216	89	45	208	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		65	27	14	63	
Hourly Flow Rate, HFR		260	107	54	250	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	150		39			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	54		14			
Hourly Flow Rate, HFR	217		56			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		250
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		367	672		314			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	314	
Potential Capacity	731	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	731	
Probability of Queue free St.	0.92	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	367	
Potential Capacity	1144	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1144	
Probability of Queue free St.	0.95	1.00
Maj L-Shared Prob Q free St.	0.94	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	672	
Potential Capacity	424	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.88
Movement Capacity	404	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.94 0.94
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 672
Potential Capacity 424
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.94
Maj. L, Min T Adj. Imp Factor. 0.96
Cap. Adj. factor due to Impeding mvmnt 0.95 0.88
Movement Capacity 404

Results for Two-stage process:

a
y
C t 404

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	217		56			
Movement Capacity (vph)	404		731			
Shared Lane Capacity (vph)		445				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	404		731			
Volume	217		56			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		445				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		54		273				
C(m) (vph)		1144		445				
v/c		0.05		0.61				
95% queue length		0.15		4.01				
Control Delay		8.3		25.1				
LOS		A		D				
Approach Delay				25.1				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.95
v(il), Volume for stream 2 or 5		250
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.94
d(M,LT), Delay for stream 1 or 4		8.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.5

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	284	34	227	0	205	308	121	160	9
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	708	1699	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	530	1272	0.69	0.42	21.1	C	19.1	B
R	514	1233	0.51	0.42	16.3	B		

Northbound

LTR	710	1703	0.85	0.42	26.7	C	26.7	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	293	703	1.14	0.42	112.1	F	112.1	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 41.6 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	284	34	227	0	205	308	121	160	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	82	10	65	0	60	91	35	46	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			365	261		603			333	
%InSharedLn												
Prop LTs		0.273			0.893			0.000			0.417	
Prop RTs		0.091			0.000	1.000		0.600			0.030	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	284	34	227	0	205	308	121	160	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	326	39	261	0	241	362	139	184	10
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			365 261			603			333		
Prop LTs	0.273			0.893			0.000			0.417		
Prop RTs	0.091			0.000 1.000			0.600			0.030		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.919			0.996		
fLT	0.936			0.741			1.000			0.368		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1699			1272 1233			1703			703		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1699	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	365	1272	# 0.29	0.42	530	0.69
Right	R	261	1233	0.21	0.42	514	0.51
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1703	0.35	0.42	710	0.85
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	333	703	# 0.47	0.42	293	1.14
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.91

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.69	0.42	14.3	1.000	530	0.50	6.7	0.0	21.1	C	19.1	B
R	0.51	0.42	12.9	1.000	514	0.50	3.3	0.0	16.3	B		
Northbound												
LTR	0.85	0.42	15.8	1.000	710	0.50	10.9	0.0	26.7	C	26.7	C
Southbound												
LTR	1.14	0.42	17.5	1.000	293	0.50	94.6	0.0	112.1	F	112.1	F

Intersection delay = 41.6 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	326	0	139
Proportion of LT in LT lane group, PLT	0.273	0.893	0.000	0.417
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.42	0.00
Adjusted opposing flow rate, Vo (veh/h)	365	11	333	603
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.43	0.00	2.32
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.08	0.18	5.55	10.05
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	0.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	6.04	0.00	5.30	11.19
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	19.70	13.81
n=Max(gq-gf)/2,0)	0.00	0.00	2.65	5.19
PTHo=1-PLTo	0.11	0.73	0.58	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.42
EL1 (refer to Exhibit C16-3)	2.01	1.39	1.95	2.54
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.82	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdif=max(gq-gf,0)	0.00	0.00	5.30	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.37
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.936	0.741	1.000	0.368

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	6.04			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.242			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	365			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	21.1
R	0.0	0.00	17.5	12.9	0.00	0.0	0.0	16.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.8	0.00	0.0	0.0	26.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	10.0	0.0	112.1
	0.0						0.0	
Intersection Delay			41.6	sec/veh	Intersection LOS		D	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		LTR		
Init Queue	0.0			0.0	0.0	0.0		0.0		
Flow Rate	11			365	261	603		333		
So	1900			1900	1900	1900		1900		
No.Lanes	0	1	0	0	1	1	0	1	0	0
SL	1699			1272	1233	1703		703		
LnCapacity	708			530	514	710		293		
Flow Ratio	0.0			0.3	0.2	0.4		0.5		
v/c Ratio	0.02			0.69	0.51	0.85		1.14		
Grn Ratio	0.42			0.42	0.42	0.42		0.42		
I Factor	1.000			0.940		0.887		1.000		
AT or PVG	3			3	3	3		3		
Pltn Ratio	1.00			1.00	1.00	1.00		1.00		
PF2	1.00			1.00	1.00	1.00		1.00		
Q1	0.1			5.0	3.2	9.1		5.6		
kB	0.7			0.5	0.5	0.6		0.4		
Q2	0.0			1.1	0.5	2.8		7.1		
Q Average	0.1			6.1	3.7	11.9		12.7		
Q Spacing	25.0			25.0	25.0	25.0		25.0		
Q Storage	0			0	0	0		0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2		
BOQ	0.2			7.5	4.7	14.4		15.3		
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.5	1.4		1.4		
BOQ	0.2			9.0	5.8	16.9		18.0		
QSRatio										
90th Percentile Output:										
fB%	2.0			1.6	1.7	1.5		1.5		
BOQ	0.2			10.0	6.5	18.4		19.5		
QSRatio										
95th Percentile Output:										
fB%	2.6			1.9	2.1	1.7		1.7		
BOQ	0.3			11.5	7.7	20.1		21.3		
QSRatio										
98th Percentile Output:										
fB%	3.2			2.1	2.4	1.8		1.8		
BOQ	0.4			13.0	9.0	21.8		23.1		
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				160		5		508			443	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 631 1894 0.30 0.33 15.9 B 15.9 B

Northbound

T 970 1940 0.62 0.50 13.4 B 13.4 B

Southbound

T 925 1850 0.55 0.50 12.1 B 12.1 B

Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				160		5	508			443		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				45		2	149			127		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					188		598			509		
%InSharedLn												
Prop LTs					0.968		0.000			0.000		
Prop RTs					0.032		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0						30.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				160		5	508			443		
PHF				0.88		0.88	0.85			0.87		
Adj flow				182		6	598			509		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					188			598			509	
Prop LTs					0.968			0.000			0.000	
Prop RTs					0.032			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.996			1.000			1.000	
fLT					0.954			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1894			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	188	1894	# 0.10	0.33	631	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	598	1940	# 0.31	0.50	970	0.62
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	509	1850	0.28	0.50	925	0.55
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.49

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.30	0.33	14.8	1.000	631	0.50	1.1	0.0	15.9	B	15.9	B	
Northbound													
T	0.62	0.50	10.8	1.000	970	0.50	2.6	0.0	13.4	B	13.4	B	
Southbound													
T	0.55	0.50	10.3	1.000	925	0.50	1.8	0.0	12.1	B	12.1	B	

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.968 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	15.9
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.8	0.00	0.0	0.0	13.4
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.3	0.00	0.0	0.0	12.1
	0.0						0.0	
Intersection Delay			13.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		508	223	119	484	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		149	66	34	139	
Hourly Flow Rate, HFR		597	262	136	556	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		556
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		859						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	859	
Potential Capacity	711	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	711	
Probability of Queue free St.	0.81	1.00
Maj L-Shared Prob Q free St.	0.72	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.72	0.72
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.81	0.81
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		136						
C(m) (vph)		711						
v/c		0.19						
95% queue length		0.70						
Control Delay		11.3						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.81
v(il), Volume for stream 2 or 5		556
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.72
d(M,LT), Delay for stream 1 or 4		11.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		3.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				62		179	549	74		120	359	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 382 1434 0.68 0.27 28.8 C 28.8 C

Northbound

TR 1033 1823 0.71 0.57 12.6 B 12.6 B

Southbound

LT 636 1122 0.87 0.57 23.8 C 23.8 C

Intersection Delay = 19.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				62		179	549	74		120	359	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				17		48	161	22		34	103	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					259			733			551	
%InSharedLn												
Prop LTs					0.259			0.000			0.250	
Prop RTs					0.741			0.119			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				62		179	549	74		120	359	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				67		192	646	87		138	413	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					259			733			551	
Prop LTs					0.259			0.000			0.250	
Prop RTs					0.741			0.119			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound			Northbound			Southbound		
LG						LR			TR			LT	
So						1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0	
fW						1.000			1.100			1.100	
fHV						0.971			0.901			0.917	
fG						1.000			1.000			1.000	
fP						0.875			1.000			1.000	
fBB						1.000			0.984			0.988	
fA						1.000			1.000			1.000	
fLU						1.000			1.000			1.000	
fRT						0.900			0.984			1.000	
fLT						0.987			1.000			0.592	
Sec.													
fLpb						1.000			1.000			1.000	
fRpb						1.000			1.000			1.000	
S						1434			1823			1122	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	259	1434	# 0.18	0.27	382	0.68
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	733	1823	0.40	0.57	1033	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	551	1122	# 0.49	0.57	636	0.87
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.68	0.27	19.7	1.000	382	0.50	9.1	0.0	28.8	C	28.8	C
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Northbound

TR	0.71	0.57	9.4	1.000	1033	0.50	3.2	0.0	12.6	B	12.6	B
----	------	------	-----	-------	------	------	-----	-----	------	---	------	---

Southbound

LT	0.87	0.57	11.1	1.000	636	0.50	12.7	0.0	23.8	C	23.8	C
----	------	------	------	-------	-----	------	------	-----	------	---	------	---

Intersection delay = 19.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			138
Proportion of LT in LT lane group, PLT	0.259	0.000	0.250
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			733
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.30
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.22
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			3.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.29
n=Max(gq-gf)/2,0)			2.87
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.25
EL1 (refer to Exhibit C16-3)			2.89
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.592

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.71
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.256
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				733
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.250
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.741	0.119
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.7	0.00	0.0	0.0	28.8
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.4	0.00	0.0	0.0	12.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	11.1	0.00	0.0	0.0	23.8
	0.0						0.0	
Intersection Delay			19.3	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	71	27	94	23	133	50	90	672	112	67	367	30
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	558	1621	0.38	0.34	23.9	C	23.9	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	576	1671	0.38	0.34	24.1	C	24.1	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	397	729	0.25	0.54	11.8	B		
TR	1048	1925	0.81	0.54	21.3	C	20.4	C

Southbound

LTR	952	1749	0.57	0.54	16.1	B	16.1	B
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 20.0- (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	27	94	23	133	50	90	672	112	67	367	30
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	20	8	26	6	35	13	24	183	30	20	109	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		213			218		98	852			546	
%InSharedLn												
Prop LTs		0.371			0.110		1.000	0.000			0.147	
Prop RTs		0.488			0.243			0.143			0.053	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	27	94	23	133	50	90	672	112	67	367	30
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	79	30	104	24	141	53	98	730	122	80	437	29
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	213			218			98 852			546		
Prop LTs	0.371			0.110			1.000 0.000			0.147		
Prop RTs	0.488			0.243			0.143			0.053		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.934			0.967			0.979			0.992		
fLT	0.814			0.954			0.423 1.000			0.596		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1621			1671			729 1925			1749		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	213	1621	# 0.13	0.34	558	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	218	1671	0.13	0.34	576	0.38
Right							
Northbound							
Prot							
Perm							
Left	L	98	729	0.13	0.54	397	0.25
Prot							
Perm							
Thru	TR	852	1925	# 0.44	0.54	1048	0.81
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	546	1749	0.31	0.54	952	0.57
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.57

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.38	0.34	22.3	1.000	558	0.50	1.6	0.0	23.9	C	23.9	C	
Westbound													
LTR	0.38	0.34	22.2	1.000	576	0.50	1.9	0.0	24.1	C	24.1	C	
Northbound													
L	0.25	0.54	10.8	1.000	397	0.50	1.0	0.0	11.8	B			
TR	0.81	0.54	16.8	1.000	1048	0.50	4.6	0.0	21.3	C	20.4	C	
Southbound													
LTR	0.57	0.54	13.6	1.000	952	0.50	2.5	0.0	16.1	B	16.1	B	

Intersection delay = 20.0- (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			98	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.15	
Adjusted opposing flow rate, Vo (veh/h)			546	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.45	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.17	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			2.77	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			46.23	
n=Max(gq-gf)/2,0)			1.38	
PTHo=1-PLTo			0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.23	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.34	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			2.77	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.42	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.423	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	79	24	80
Proportion of LT in LT lane group, PLT	0.371	0.110	0.000
Proportion of LT in opposing flow, PLTo	0.11	0.37	0.00
Adjusted opposing flow rate, Vo (veh/h)	218	213	852
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.98	0.60	2.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.45	5.32	21.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.3	11.6	6.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	6.50	6.29	31.85
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.50	19.38	17.15
n=Max(gq-gf)/2,0)	1.61	0.00	12.68
PTHo=1-PLTo	0.89	0.63	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.11	0.59
EL1 (refer to Exhibit C16-3)	1.73	1.72	3.24
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.55	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.07
gdifff=max(gq-gf,0)	3.21	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.95	0.28
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.814	0.954	0.596

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	6.50	6.29	2.77	31.85
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.210	0.203	0.057	0.650
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	218	213	546	852
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.371	0.110	1.000	0.147
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.488	0.243	0.143	0.053
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.3	0.00	0.0	0.0	23.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.2	0.00	0.0	0.0	24.1
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	10.8	0.00	0.0	0.0	11.8
TR	0.0	0.00	20.5	16.8	0.00	0.0	0.0	21.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	13.6	0.00	0.0	0.0	16.1
	0.0						0.0	
Intersection Delay			20.0-	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	213		218		98	852	286	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1621		1671		729	1925	918	
LnCapacity	558		576		397	1048	499	
Flow Ratio	0.1		0.1		0.1	0.4	0.3	
v/c Ratio	0.38		0.38		0.25	0.81	0.57	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.0		4.1		1.3	17.4	4.7	
kB	0.6		0.8		0.4	0.8	0.7	
Q2	0.4		0.5		0.1	3.0	0.9	
Q Average	4.4		4.6		1.4	20.4	5.6	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	5.5		5.7		1.8	24.5	6.9	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	6.7		7.0		2.3	28.6	8.4	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.7	
BOQ	7.5		7.8		2.7	30.7	9.4	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.0		2.4	1.6	1.9	
BOQ	8.9		9.2		3.3	33.0	10.8	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.3		2.8	1.7	2.2	
BOQ	10.2		10.5		4.0	35.2	12.3	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	283						793			405		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0					50.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.47	0.33	26.1	C	26.1	C

Westbound

Northbound

T 2156 3880 0.40 0.56 11.8 B 11.8 B

Southbound

T 1951 3512 0.25 0.56 10.6 B 10.6 B

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	283						793			405		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	79						218			121		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	314						871			482		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	283						793			405		
PHF	0.90						0.91			0.84		
Adj flow	314						871			482		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	314						871			482		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.990				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3880				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	314	2006	# 0.16	0.33	669	0.47
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	871	3880	# 0.22	0.56	2156	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	482	3512	0.14	0.56	1951	0.25
Right							

Sum of flow ratios for critical lane groups,
 $Y_c = \text{Sum (v/s)} = 0.38$

Total lost time per cycle,
 $L = 10.00 \text{ sec}$

Critical flow rate to capacity ratio,
 $X_c = (Y_c)(C)/(C-L) = 0.43$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.47	0.33	23.7	1.000	669	0.50	2.4	0.0	26.1	C	26.1	C	
Westbound													
Northbound													
T	0.40	0.56	11.5	1.000	2156	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.25	0.56	10.3	1.000	1951	0.50	0.3	0.0	10.6	B	10.6	B	

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.7	0.00	0.0	0.0	26.1
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.5	0.00	0.0	0.0	11.8
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.3	0.00	0.0	0.0	10.6
	0.0						0.0	
Intersection Delay			14.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	314						457		253	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.2						0.2		0.1	
v/c Ratio	0.47						0.40		0.25	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.2						6.5		3.3	
kB	0.9						0.8		1.1	
Q2	0.7						0.6		0.4	
Q Average	7.0						7.1		3.6	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	8.5						8.7		4.5	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.3						10.5		5.6	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	11.3						11.5		6.3	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		2.1	
BOQ	12.9						13.1		7.6	
QSRatio										
98th Percentile Output:										
fB%	2.1						2.1		2.4	
BOQ	14.4						14.6		8.8	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					405	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					121	
Hourly Flow Rate, HFR					482	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						59
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						21
Hourly Flow Rate, HFR						84
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								241
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		241
Potential Capacity		674
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		674
Probability of Queue free St.	1.00	0.88
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	557
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	557
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	557	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	557	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	625
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	625

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	804	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity	704	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						84
Movement Capacity (vph)						674
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						674
Volume						84
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								84
C(m) (vph)								674
v/c								0.12
95% queue length								0.42
Control Delay								11.1
LOS								B
Approach Delay							11.1	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	73	183	169	203	441	79	107	251	74	68	31	41
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	577	0.43	0.33	28.8	C		
TR	582	1746	0.61	0.33	28.9	C	28.9	C
Westbound								
L	201	604	1.16	0.33	142.3	F		
TR	1092	3277	0.54	0.33	26.3	C	59.0	E
Northbound								
LTR	910	3277	0.51	0.28	29.4	C	29.4	C
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	350	1574	0.31	0.22	31.4	C	31.1	C

Intersection Delay = 42.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	73	183	169	203	441	79	107	251	74	68	31	41
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	21	52	48	58	127	23	29	67	20	25	12	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	83	357		233	593			465		101	107	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.247			0.000	
Prop RTs		0.417			0.145			0.172			0.570	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	73	183	169	203	441	79	107	251	74	68	31	41
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	83	208	149	233	507	86	115	270	80	101	46	61
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	83	357		233	593			465		101	107	
Prop LTs	1.000	0.000		1.000	0.000			0.247			0.000	
Prop RTs		0.417			0.145			0.172			0.570	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.980	0.980		0.926	0.926			0.926		0.971	0.971	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.937			0.978			0.974			0.914	
fLT	0.321	1.000		0.368	1.000			0.988		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	577	1746		604	3277			3277		1694	1574	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	83	577	0.14	0.33	192	0.43
Prot							
Perm							
Thru	TR	357	1746	0.20	0.33	582	0.61
Right							
Westbound							
Prot							
Perm							
Left	L	233	604	# 0.39	0.33	201	1.16
Prot							
Perm							
Thru	TR	593	3277	0.18	0.33	1092	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	465	3277	# 0.14	0.28	910	0.51
Right							
Southbound							
Prot							
Perm							
Left	L	101	1694	0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	107	1574	# 0.07	0.22	350	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.71

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.43	0.33	23.4	1.000	192	0.50	5.5	0.0	28.8	C			
TR	0.61	0.33	25.1	1.000	582	0.50	3.7	0.0	28.9	C	28.9	C	
Westbound													
L	1.16	0.33	30.0	1.000	201	0.50	112.3	0.0	142.3	F			
TR	0.54	0.33	24.4	1.000	1092	0.50	1.9	0.0	26.3	C	59.0	E	
Northbound													
LTR	0.51	0.28	27.4	1.000	910	0.50	2.0	0.0	29.4	C	29.4	C	
Southbound													
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C			
TR	0.31	0.22	29.2	1.000	350	0.50	2.2	0.0	31.4	C	31.1	C	

Intersection delay = 42.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	83	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	593	357		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.08	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.79	8.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.55	9.84		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.45	20.16		
n=Max(gq-gf)/2,0)	3.78	4.92		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.33	1.83		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.37		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.321	0.368		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.247 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdif = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdif / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.55			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.252			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	593			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.145
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	23.4	0.00	0.0	0.0	28.8
TR	0.0	0.00	30.0	25.1	0.00	0.0	0.0	28.9
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	8.0	0.0	142.3
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	27.4	0.00	0.0	0.0	29.4
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	29.2	0.00	0.0	0.0	31.4
	0.0						0.0	

Intersection Delay	42.1	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	83	357		233	311		244			101	107	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	577	1746		604	1721		1721			1694	1574	
LnCapacity	192	582		201	573		477			376	350	
Flow Ratio	0.1	0.2		0.4	0.2		0.1			0.1	0.1	
v/c Ratio	0.43	0.61		1.16	0.54		0.51			0.27	0.31	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.6	7.5		5.8	6.3		5.1			2.1	2.2	
kB	0.3	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.2	0.9		5.8	0.9		0.7			0.2	0.2	
Q Average	1.8	8.4		11.6	7.2		5.8			2.3	2.5	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	2.3	10.3		14.1	8.8		7.2			2.9	3.1	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.6	
BOQ	2.9	12.3		16.6	10.6		8.7			3.7	3.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.5	1.6		1.7			1.8	1.8	
BOQ	3.4	13.4		18.0	11.7		9.7			4.2	4.5	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.8		1.7	1.8		1.9			2.2	2.2	
BOQ	4.2	15.0		19.8	13.2		11.1			5.1	5.5	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0		1.8	2.1		2.2			2.6	2.6	
BOQ	5.0	16.7		21.5	14.8		12.6			6.1	6.5	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume							404		
Peak-Hour Factor, PHF							0.95		
Hourly Flow Rate, HFR							425		
Percent Heavy Vehicles			--	--			--	--	
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes							1		
Configuration							T		
Upstream Signal?			No				No		
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		178							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		191							
Percent Heavy Vehicles		8							
Percent Grade (%)			0				0		
Flared Approach: Exists?/Storage					/			/	
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			191							
C(m) (vph)			575							
v/c			0.33							
95% queue length			1.45							
Control Delay			14.3							
LOS			B							
Approach Delay				14.3						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 404
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 106
 Hourly Flow Rate, HFR 425
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 48
 Hourly Flow Rate, HFR 191
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			425					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	425	
Potential Capacity	575	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	575	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 425
Potential Capacity 575
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 575

Results for Two-stage process:
a
y
C t 575

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	191					
Movement Capacity (vph)	575					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	575					
Volume	191					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			191					
C(m) (vph)			575					
v/c			0.33					
95% queue length			1.45					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	69	28	33	92	67	14	16	21	21	52	16
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.80	0.80	0.78	0.78	0.86	0.86	1.00	1.00
Flow Rate	49	77	100	143	34	24	47	42
% Heavy Veh	21	21	1	1	5	5	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	49	77	100	143	34	24	47	42
Left-Turn	7	0	42	0	16	0	21	0
Right-Turn	0	34	0	85	0	24	0	16
Prop. Left-Turns	0.1	0.0	0.4	0.0	0.5	0.0	0.4	0.0
Prop. Right-Turns	0.0	0.4	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7	-0.7	-0.7	-0.7
hHV-adj	1.7	1.7	1.7	1.7
hadj, computed	0.4	0.0	0.2	-0.4
	0.3	-0.6	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	49	77	100	143	34	24	47	42
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.04	0.07	0.09	0.13	0.03	0.02	0.04	0.04
hd, final value	5.53	5.15	5.24	4.61	5.79	4.86	5.66	5.17
x, final value	0.08	0.11	0.15	0.18	0.05	0.03	0.07	0.06
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	3.2	2.9	2.9	2.3	3.5	2.6	3.4	2.9

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	49	77	100	143	34	24	47	42
Service Time	3.2	2.9	2.9	2.3	3.5	2.6	3.4	2.9
Utilization, x	0.08	0.11	0.15	0.18	0.05	0.03	0.07	0.06
Dep. headway, hd	5.53	5.15	5.24	4.61	5.79	4.86	5.66	5.17
Capacity	299	327	350	393	284	274	297	292
Delay	8.68	8.49	8.83	8.34	8.83	7.72	8.81	8.20
LOS	A	A	A	A	A	A	A	A
Approach:								
Delay	8.57		8.54		8.37		8.52	
LOS	A		A		A		A	
Intersection Delay	8.52				Intersection LOS A			

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	54	32	227	177	355	6	270	93	51	11	160	102
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0				29.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 756 2959 0.47 0.26 30.3 C 30.3 C

Westbound

LTR 882 3450 0.70 0.26 34.8 C 34.8 C

Northbound

DefL 303 940 1.02 0.32 88.3 F
 TR 576 1787 0.29 0.32 24.0 C 65.9 E

Southbound

LTR 880 2732 0.41 0.32 25.2 C 25.2 C

Intersection Delay = 40.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	54	32	227	177	355	6	270	93	51	11	160	102
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	64	51	102	2	78	27	15	4	53	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		355			618		310	166			359	
%InSharedLn												
Prop LTs		0.172			0.328		1.000	0.000			0.039	
Prop RTs		0.727			0.011			0.355			0.373	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	54	32	227	177	355	6	270	93	51	11	160	102
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	61	36	258	203	408	7	310	107	59	14	211	134
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	355			618			310 166			359		
Prop LTs	0.172			0.328			1.000 0.000			0.039		
Prop RTs	0.727			0.011			0.355			0.373		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.891			0.998			0.947			0.944		
fLT	0.991			0.984			0.498 1.000			0.943		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2959			3450			940 1787			2732		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	355	2959	# 0.12	0.26	756	0.47
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	618	3450	# 0.18	0.26	882	0.70
Right							
Northbound							
Prot							
Perm							
Left	DefL	310	940	# 0.33	0.32	303	1.02
Prot							
Perm							
Thru	TR	166	1787	0.09	0.32	576	0.29
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	359	2732	0.13	0.32	880	0.41
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.47	0.26	28.3	1.000	756	0.50	1.9	0.0	30.3	C	30.3	C	
Westbound													
LTR	0.70	0.26	30.4	1.000	882	0.50	4.4	0.0	34.8	C	34.8	C	
Northbound													
DefL	1.02	0.32	30.5	1.000	303	0.50	57.8	0.0	88.3	F			
TR	0.29	0.32	22.8	1.000	576	0.50	1.3	0.0	24.0	C	65.9	E	
Southbound													
LTR	0.41	0.32	23.8	1.000	880	0.50	1.4	0.0	25.2	C	25.2	C	

Intersection delay = 40.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			310	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			359	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.75	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.71	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			2.14	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.86	
n=Max(gq-gf)/2,0)			1.07	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.86	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.07	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			2.14	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.50	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.498	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	14
Proportion of LT in LT lane group, PLT	0.172 0.328 0.000 0.039
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	166
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.35
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	14.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.86
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	1.64
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdif=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.943

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				166
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.039
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.727	0.011	0.355
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	28.3	0.00	0.0	0.0	30.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	30.4	0.00	0.0	0.0	34.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	1.7	0.0	88.3
TR	0.0	0.00	30.5	22.8	0.00	0.0	0.0	24.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	23.8	0.00	0.0	0.0	25.2
	0.0						0.0	
Intersection Delay			40.2	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	186		324		310	166	188	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1554		1811		940	1787	1434	
LnCapacity	397		463		303	576	462	
Flow Ratio	0.1		0.2		0.3	0.1	0.1	
v/c Ratio	0.47		0.70		1.02	0.29	0.41	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.916		0.953			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	3.9		7.3		7.8	3.1	3.7	
kB	0.5		0.6		0.5	0.8	0.7	
Q2	0.5		1.4		4.8	0.3	0.5	
Q Average	4.4		8.7		12.6	3.4	4.1	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.3	1.2	
BOQ	5.5		10.6		15.2	4.3	5.1	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.4	1.6	1.5	
BOQ	6.7		12.7		17.9	5.3	6.3	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.6		1.5	1.8	1.7	
BOQ	7.5		13.8		19.4	6.0	7.1	
QSRatio								
95th Percentile Output:								
fB%	2.0		1.8		1.7	2.1	2.0	
BOQ	8.9		15.5		21.2	7.2	8.4	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.0		1.8	2.5	2.4	
BOQ	10.2		17.1		22.9	8.4	9.7	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	798	259	19	4	284	327	4	16	6	121	5	146
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	839	1728	1.05	0.71	55.6	E		
TR	1158	1629	0.26	0.71	5.0	A	42.5	D
Westbound								
LT	449	1835	0.75	0.24	41.5	D	60.1	E
R	383	1568	0.99	0.24	76.4	E		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.62	0.18	46.1	D		
LT	320	1801	0.02	0.18	30.6	C	24.7	C
R	952	1478	0.18	0.64	6.8	A		

Intersection Delay = 45.3 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	798	259	19	4	284	327	4	16	6	121	5	146
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	219	71	5	1	83	95	3	11	4	35	2	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	877	306			335	380		70		139	6	168
%InSharedLn										0		
Prop LTs	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTs		0.069			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603		0.932			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6		24.6			20.9			20.1		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X		X				Peds		
WB	Left			P			SB	Left	P	
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds							Peds		
NB	Right						EB	Right		
SB	Right	P					WB	Right		
Green		37.0		22.0				16.0		
Yellow		3.0		3.0				3.0		
All Red		2.0		2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	798	259	19	4	284	327	4	16	6	121	5	146
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	877	285	21	5	330	380	11	43	16	139	6	168
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L TR			LT R			LTR			L LT R		
Adj flow	877	306		335	380		70			139	6	168
Prop LTs	1.000	0.000		0.015			0.157			1.000	0.000	
Prop RTs	0.069			0.000	1.000		0.229			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.990		1.000	0.850		0.969				1.000	0.850
fLT	0.950	1.000		0.995			0.965			0.732	1.000	
Sec.	0.237											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1629		1835	1568		1995			1273	1801	1478
Sec.	431											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		167	431	# 0.39	0.300	129	1.29
Left	L	877			0.71	839	1.05
Prot							
Perm							
Thru	TR	306	1629	0.19	0.71	1158	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	335	1835	0.18	0.24	449	0.75
Right	R	380	1568	0.24	0.24	383	0.99
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	139	1273	# 0.11	0.18	226	0.62
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	168	1478	0.11	0.64	952	0.18

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.02

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.05	0.71	18.7	1.000	839	0.50	36.9	0.0	55.6	E			
TR	0.26	0.71	4.6	1.000	1158	0.50	0.3	0.0	5.0	A	42.5	D	
Westbound													
LT	0.75	0.24	31.4	1.000	449	0.50	10.1	0.0	41.5	D	60.1	E	
R	0.99	0.24	33.9	1.000	383	0.50	42.5	0.0	76.4	E			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.62	0.18	34.2	1.000	226	0.50	11.9	0.0	46.1	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	24.7	C	

R 0.18 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 45.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	877			139
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.16
Adjusted opposing flow rate, Vo (veh/h)	335			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.93			3.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.38			1.75
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	15.55			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.45			14.85
n=Max(gq-gf)/2,0)	7.77			0.58
PTHo=1-PLTo	0.99			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.79			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.39			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	15.55			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.24			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.237			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.015	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	306	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.65	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.89	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdif=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		306		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.015		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.069
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	877			
v/c ratio from Capacity Worksheet, X	1.05			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	15.55			
Unopposed green interval, gu	11.45			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	1.95			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	9.12			
Queue at beginning of unsaturated green, Qu	3.62			
Residual queue, Qr	3.06			
Uniform Delay, d1	18.7			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		18.7	0.00	9.5	0.0	55.6
TR	0.0	0.00	13.0	4.6	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.4	0.00	0.0	0.0	41.5
R	0.0	0.00	34.0	33.9	0.00	0.0	0.0	76.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	34.2	0.00	0.0	0.0	46.1
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8
Intersection Delay			45.3	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	877	306		335	380	70		139	6	168
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1181	1629		1835	1568	1995		1273	1801	1478
LnCapacity	839	1158		449	383	355		226	320	952
Flow Ratio	0.7	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	1.05	0.26		0.75	0.99	0.20		0.62	0.02	0.18
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	10.8	2.7		7.7	9.5	1.5		3.2	0.1	1.7
kB	0.6	0.8		0.6	0.5	0.6		0.4	0.5	1.1
Q2	10.9	0.3		1.6	4.9	0.1		0.6	0.0	0.2
Q Average	21.6	3.0		9.3	14.4	1.6		3.8	0.1	1.9
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2	1.3		1.2	1.3	1.3
BOQ	26.0	3.8		11.4	17.3	2.1		4.8	0.2	2.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.4	1.4	1.6		1.5	1.7	1.6
BOQ	30.4	4.7		13.5	20.4	2.6		5.9	0.2	3.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.5	1.9		1.7	2.0	1.8
BOQ	32.6	5.3		14.7	22.0	3.0		6.6	0.3	3.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8	1.7	2.3		2.1	2.6	2.3
BOQ	34.9	6.4		16.4	23.8	3.8		7.9	0.3	4.4
QSRatio										
98th Percentile Output:										
fB%	1.7	2.5		1.9	1.8	2.8		2.4	3.2	2.7
BOQ	37.2	7.6		18.0	25.7	4.5		9.2	0.4	5.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/13	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2020 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	361	26	0	14	68	38	6	21	11	15	38	512
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	699	1397	0.57	0.50	18.9	B		
TR	1066	2132	0.03	0.50	11.5	B	18.4	B

LTR	1543	3086	0.10	0.50	12.0	B	12.0	B
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LTR	1232	3168	0.07	0.39	17.4	B	17.4	B
-----	------	------	------	------	------	---	------	---

LT	673	1730	0.10	0.39	17.8	B	30.5	C
R	616	1583	0.76	0.39	32.4	C		

Intersection Delay = 22.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	361	26	0	14	68	38	6	21	11	15	38	512
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
PK 15 Vol	99	7	0	5	24	13	3	12	6	5	13	168
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9		0				155
Adj Flow	397	29			153			84			70	470
%InSharedLn												
Prop LTs	1.000	0.000			0.124			0.155			0.286	
Prop RTs		0.000			0.261			0.286			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.970			1.000			1.000			0.974	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	361	26	0	14	68	38	6	21	11	15	38	512
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	397	29	0	19	94	40	13	47	24	20	50	470
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	397	29			153			84			70	470
Prop LTs	1.000	0.000			0.124			0.155			0.286	
Prop RTs		0.000			0.261			0.286			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.961			0.957		1.000	0.850
fLT	0.655	1.000			0.930			0.924		0.929	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1397	2132			3086			3168		1730	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	397	1397	# 0.28	0.50	699	0.57
Prot							
Perm							
Thru	TR	29	2132	0.01	0.50	1066	0.03
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	153	3086	0.05	0.50	1543	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	84	3168	0.03	0.39	1232	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	70	1730	0.04	0.39	673	0.10
Right	R	470	1583	# 0.30	0.39	616	0.76

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.57	0.50	15.7	1.000	699	0.50	3.2	0.0	18.9	B			
TR	0.03	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.5	B	18.4	B	
Westbound													
LTR	0.10	0.50	11.8	1.000	1543	0.50	0.1	0.0	12.0	B	12.0	B	
Northbound													
LTR	0.07	0.39	17.3	1.000	1232	0.50	0.1	0.0	17.4	B	17.4	B	
Southbound													
LT	0.10	0.39	17.5	1.000	673	0.50	0.3	0.0	17.8	B	30.5	C	

R 0.76 0.39 23.9 1.000 616 0.50 8.5 0.0 32.4 C

Intersection delay = 22.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	397			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.12			
Adjusted opposing flow rate, Vo (veh/h)	153			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	9.93			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.01			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.88			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.53			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.655			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No		2	1	2
Adjusted LT flow rate, VLT (veh/h)		19	13	20
Proportion of LT in LT lane group, PLT	0.000	0.124	0.155	0.286
Proportion of LT in opposing flow, PLTo		0.00	0.29	0.15
Adjusted opposing flow rate, Vo (veh/h)		29	70	84
Lost time for LT lane group, tL		5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600		0.48	0.33	0.50
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.36	1.75	1.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		21.8	18.6	15.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		23.17	16.40	19.53
n=Max(gq-gf)/2,0)		0.00	0.00	0.00
PTHo=1-PLTo		1.00	0.71	0.85
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.26	0.31	0.29
EL1 (refer to Exhibit C16-3)		1.42	1.48	1.51
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	0.08	0.07
gdifff=max(gq-gf,0)		0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	0.94	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.930	0.924	0.929

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	153	29	70	84
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.124	0.155	0.286
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.261	0.286	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.7	0.00	0.0	0.0	18.9
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	12.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.3	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.5	0.00	0.0	0.0	17.8
R	0.0	0.00	27.5	23.9	0.00	0.0	0.0	32.4
Intersection Delay			22.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	397	29			80			44			70	470
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1397	2132			1620			1663			1730	1583
LnCapacity	699	1066			810			647			673	616
Flow Ratio	0.3	0.0			0.0			0.0			0.0	0.3
v/c Ratio	0.57	0.03			0.10			0.07			0.10	0.76
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.970			1.000			1.000			0.974	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	6.9	0.4			1.1			0.7			1.1	10.2
kB	0.9	1.2			1.0			0.8			0.8	0.8
Q2	1.1	0.0			0.1			0.1			0.1	2.3
Q Average	8.0	0.4			1.2			0.8			1.2	12.5
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	9.8	0.5			1.5			1.0			1.5	15.1
QSRatio												
85th Percentile Output:												
fB%	1.5	1.7			1.6			1.7			1.6	1.4
BOQ	11.7	0.7			1.9			1.2			2.0	17.8
QSRatio												
90th Percentile Output:												
fB%	1.6	2.0			1.9			1.9			1.9	1.5
BOQ	12.9	0.8			2.2			1.5			2.3	19.2
QSRatio												
95th Percentile Output:												
fB%	1.8	2.5			2.4			2.5			2.4	1.7
BOQ	14.5	1.0			2.8			1.8			2.9	21.0
QSRatio												
98th Percentile Output:												
fB%	2.0	3.1			2.9			3.0			2.9	1.8
BOQ	16.1	1.2			3.4			2.2			3.5	22.8
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	107		4				4	89			534	334
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		19.0					31.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.25	0.32	16.4	B	16.4	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								

Northbound

LT 1660 3213 0.07 0.52 7.4 A 7.4 A

Southbound

TR 1976 3825 0.54 0.52 10.5 B 10.5 B

Intersection Delay = 10.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	107		4				4	89		534	334	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	33		1				1	28		165	103	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	134		0					116			1071	
%InSharedLn												
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.385	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995					1.000			0.752		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	107		4				4	89		534	334	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	134		0				5	111		659	412	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	134		0					116			1071	
Prop LTs								0.043			0.000	
Prop RTs			1.000					0.000			0.385	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.942	
fLT	0.950				0.921		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3213		3825	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	134	1680	# 0.08	0.32	532	0.25
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	116	3213	0.04	0.52	1660	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1071	3825	# 0.28	0.52	1976	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.36
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.43

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.25	0.32	15.2	1.000	532	0.50	1.1	0.0	16.4	B	16.4	B	
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B			
Westbound													
Northbound													
LT	0.07	0.52	7.3	1.000	1660	0.50	0.1	0.0	7.4	A	7.4	A	
Southbound													
TR	0.54	0.52	9.7	1.000	1976	0.50	0.8	0.0	10.5	B	10.5	B	

Intersection delay = 10.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.043 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1071
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.38
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	8.18
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.09
EL1 (refer to Exhibit C16-3)	4.20
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.921

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			8.18	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.264	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1071	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.043	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.385
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.2	0.00	0.0	0.0	16.4
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.3	0.00	0.0	0.0	7.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	9.7	0.00	0.0	0.0	10.5
	0.0						0.0	
Intersection Delay			10.9	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	134	0				60		562	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1687		2008	
LnCapacity	532	461				871		1037	
Flow Ratio	0.1	0.0				0.0		0.3	
v/c Ratio	0.25	0.00				0.07		0.54	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	1.7	0.0				0.5		6.3	
kB	0.6	0.5				0.8		0.7	
Q2	0.2	0.0				0.1		0.8	
Q Average	1.8	0.0				0.6		7.1	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.3	0.0				0.7		8.6	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	3.0	0.0				0.9		10.4	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	3.4	0.0				1.1		11.5	
QSRatio									
95th Percentile Output:									
fB%	2.3	2.6				2.5		1.8	
BOQ	4.2	0.0				1.4		13.0	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.2				3.0		2.1	
BOQ	5.0	0.0				1.7		14.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	214	0		382	191		3			24	487	121
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.34	0.42	13.1	B	13.1	B
----	-----	------	------	------	------	---	------	---

Westbound

L	402	966	1.20	0.42	130.4	F		
T	794	1906	0.30	0.42	12.7	B	91.1	F

Northbound

L	210	503	0.02	0.42	10.5	B	10.5	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2001	4802	0.39	0.42	12.8	B	12.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 44.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		214	0	382	191		3			24	487	121
% Heavy Veh		2	2	3	3		1			1	1	1
PHF		0.80	0.25	0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol		67	0	121	60		1			7	150	37
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		267		484	242		4				780	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.038	
Prop RTs		0.000			0.000						0.191	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.981			0.998		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	214	0		382	191		3			24	487	121
PHF	0.80	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	267	0		484	242		4			30	601	149
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	267			484	242		4			780		
Prop LTs	0.000			1.000	0.000		1.000			0.038		
Prop RTs	0.000			0.000						0.191		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.971	
fLT	1.000		0.507 1.000		0.286		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		966 1906		503		4802	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	267	1863	0.14	0.42	776	0.34
Right							
Westbound							
Prot							
Perm							
Left	L	484	966	# 0.50	0.42	402	1.20
Prot							
Perm							
Thru	T	242	1906	0.13	0.42	794	0.30
Right							
Northbound							
Prot							
Perm							
Left	L	4	503	0.01	0.42	210	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	780	4802	# 0.16	0.42	2001	0.39
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.34	0.42	11.9	1.000	776	0.50	1.2	0.0	13.1	B	13.1	B
Westbound												
L	1.20	0.42	17.5	1.000	402	0.50	112.9	0.0	130.4	F		
T	0.30	0.42	11.7	1.000	794	0.50	1.0	0.0	12.7	B	91.1	F
Northbound												
L	0.02	0.42	10.3	1.000	210	0.50	0.2	0.0	10.5	B	10.5	B
Southbound												
LTR	0.39	0.42	12.2	1.000	2001	0.50	0.6	0.0	12.8	B	12.8	B

Intersection delay = 44.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		484	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		267	780	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		8.07	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		4.45	4.77	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		3.70	4.18	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		21.30	20.82	
n=Max(gq-gf)/2,0)		1.85	2.09	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.68	2.91	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.05	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	4.18	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.51	0.29	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.507	0.286	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.038
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 0.908
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	T	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	267		484	242	4		286	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1863		966	1906	503		1762	
LnCapacity	776		402	794	210		734	
Flow Ratio	0.1		0.5	0.1	0.0		0.2	
v/c Ratio	0.34		1.20	0.30	0.02		0.39	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.981		0.998	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	3.0		8.1	2.7	0.0		3.3	
kB	0.7		0.4	0.7	0.3		0.7	
Q2	0.4		12.4	0.3	0.0		0.4	
Q Average	3.4		20.5	3.0	0.0		3.8	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	4.3		24.6	3.8	0.1		4.7	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.4	1.6	1.7		1.5	
BOQ	5.3		28.8	4.7	0.1		5.8	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.5	1.8	2.0		1.7	
BOQ	6.0		30.9	5.3	0.1		6.5	
QSRatio								
95th Percentile Output:								
fB%	2.1		1.6	2.1	2.6		2.1	
BOQ	7.2		33.1	6.5	0.1		7.8	
QSRatio								
98th Percentile Output:								
fB%	2.5		1.7	2.5	3.2		2.4	
BOQ	8.4		35.3	7.6	0.1		9.0	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	214
Peak-Hour Factor, PHF	0.82
Hourly Flow Rate, HFR	260
Percent Heavy Vehicles	--
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	193
Peak Hour Factor, PHF	0.78
Hourly Flow Rate, HFR	247
Percent Heavy Vehicles	1
Percent Grade (%)	0
Flared Approach: Exists?/Storage	/
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	247
C(m) (vph)	781
v/c	0.32
95% queue length	1.36
Control Delay	11.7
LOS	B
Approach Delay	11.7
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		214				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		65				
Hourly Flow Rate, HFR		260				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			193			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			62			
Hourly Flow Rate, HFR			247			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					260			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	260	
Potential Capacity	781	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	781	
Probability of Queue free St.	0.68	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.68
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			781			
Volume			247			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					247			
C(m) (vph)					781			
v/c					0.32			
95% queue length					1.36			
Control Delay					11.7			
LOS					B			
Approach Delay				11.7				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	62	21	197	76	0	0	0	0	13	82	12
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	103		345				66 64	
% Heavy Veh	24		5				3 3	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	103		345				66	64
Left-Turn	0		249				16	0
Right-Turn	26		0				0	14
Prop. Left-Turns	0.0		0.7				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.2
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	68	0	0	214	20	58	53	53	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	91		295		95		91	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	91		295		95	91		
Left-Turn	7		0		66	0		
Right-Turn	0		25		0	60		
Prop. Left-Turns	0.1		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	79	200	153	6	73	1	500	76	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	586	1674	0.60	0.35	20.6	C	19.0	B
R	549	1568	0.30	0.35	15.6	B		

Westbound

LTR	548	1567	0.18	0.35	14.3	B	14.3	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2250	4655	0.34	0.48	10.0-	A	10.0-	A
-----	------	------	------	------	-------	---	-------	---

Southbound

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	200	153	6	73	1	500	76	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	25	63	48	2	23	1	164	25	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		353	167		101			759				
%InSharedLn												
Prop LTs		0.283			0.079			0.867				
Prop RTs		0.000	1.000		0.010			0.001				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	200	153	6	73	1	500	76	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	100	253	167	8	92	1	658	100	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow		353	167		101			759				
Prop LTs		0.283			0.079			0.867				
Prop RTs		0.000	1.000		0.010			0.001				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.971	0.971	0.990		0.971			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.999		1.000			
fLT	0.878		0.969		0.958			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1674	1568	1567		4655			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.60	0.35	16.1	1.000	586	0.50	4.5	0.0	20.6	C	19.0	B
R	0.30	0.35	14.2	1.000	549	0.50	1.4	0.0	15.6	B		
Westbound												
LTR	0.18	0.35	13.5	1.000	548	0.50	0.7	0.0	14.3	B	14.3	B
Northbound												
LTR	0.34	0.48	9.6	1.000	2250	0.50	0.4	0.0	10.0-	A	10.0-	A
Southbound												

Intersection delay = 13.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	100	8	
Proportion of LT in LT lane group, PLT	0.283	0.079	0.867
Proportion of LT in opposing flow, PLTo	0.08	0.28	
Adjusted opposing flow rate, Vo (veh/h)	101	353	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.67	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.68	5.88	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.4	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	7.08	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.58	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.92	0.72	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.28	0.08	
EL1 (refer to Exhibit C16-3)	1.53	1.99	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.88	0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.878	0.969	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	7.08		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.337		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	101	353	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.283	0.079	0.867	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.010	0.001
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	16.1	0.00	0.0	0.0	20.6
R	0.0	0.00	19.5	14.2	0.00	0.0	0.0	15.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.6	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			13.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound		
LaneGroup	LT	R	LTR	LTR				
Init Queue	0.0	0.0	0.0	0.0				
Flow Rate	353	167	101	278				
So	1900	1900	1900	1900				
No.Lanes	0 1	1	0 1	0 3	0	0	0	0
SL	1674	1568	1567	1708				
LnCapacity	586	549	548	825				
Flow Ratio	0.2	0.1	0.1	0.2				
v/c Ratio	0.60	0.30	0.18	0.34				
Grn Ratio	0.35	0.35	0.35	0.48				
I Factor	0.999		0.998	0.978				
AT or PVG	3	3	3	3				
Pltn Ratio	1.00	1.00	1.00	1.00				
PF2	1.00	1.00	1.00	1.00				
Q1	4.8	2.0	1.2	2.9				
kB	0.6	0.6	0.6	0.7				
Q2	0.9	0.2	0.1	0.4				
Q Average	5.7	2.3	1.3	3.2				
Q Spacing	25.0	25.0	25.0	25.0				
Q Storage	0	0	0	0				
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3	1.3				
BOQ	7.0	2.9	1.7	4.0				
QSRatio								
85th Percentile Output:								
fB%	1.5	1.6	1.6	1.6				
BOQ	8.5	3.6	2.1	5.0				
QSRatio								
90th Percentile Output:								
fB%	1.7	1.8	1.9	1.8				
BOQ	9.5	4.1	2.4	5.7				
QSRatio								
95th Percentile Output:								
fB%	1.9	2.2	2.4	2.1				
BOQ	11.0	5.1	3.1	6.9				
QSRatio								
98th Percentile Output:								
fB%	2.2	2.7	2.9	2.5				
BOQ	12.4	6.0	3.7	8.0				
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	183		18				16	349		476		64
Lane Width		16.0						14.0		16.0		
RTOR Vol			0									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	470	1763	0.58	0.27	24.1	C	24.1	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1010	1783	0.41	0.57	8.5	A	8.5	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1093	1929	0.57	0.57	10.1	B	10.1	B
----	------	------	------	------	------	---	------	---

Intersection Delay = 12.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	183		18				16	349		476	64	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	62		6				4	98		138	19	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		271						410			627	
%InSharedLn												
Prop LTs		0.911						0.044			0.000	
Prop RTs		0.089						0.000			0.118	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	183		18				16	349		476	64	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	247		24				18	392		553	74	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		271						410			627	
Prop LTs		0.911						0.044			0.000	
Prop RTs	0.089						0.000			0.118		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.988						1.000			0.984		
fLT	0.956						0.968			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1763						1783			1929		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	271	1763	# 0.15	0.27	470	0.58
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	410	1783	0.23	0.57	1010	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	627	1929	# 0.33	0.57	1093	0.57
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.48

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.57

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.58	0.27	19.1	1.000	470	0.50	5.1	0.0	24.1	C	24.1	C
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1010	0.50	1.1	0.0	8.5	A	8.5	A
Southbound												
TR	0.57	0.57	8.3	1.000	1093	0.50	1.8	0.0	10.1	B	10.1	B

Intersection delay = 12.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.911	0.044	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		627	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.45	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		7.17	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.61	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.968	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			7.17	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.211	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			627	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.044	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.118
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.1	0.00	0.0	0.0	24.1
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.1
	0.0						0.0	
Intersection Delay			12.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	271						410			627		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1763						1783			1929		
LnCapacity	470						1010			1093		
Flow Ratio	0.2						0.2			0.3		
v/c Ratio	0.58						0.41			0.57		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.9						3.8			6.7		
kB	0.5						0.8			0.7		
Q2	0.7						0.5			1.0		
Q Average	4.6						4.4			7.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.7						5.5			9.4		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	7.0						6.7			11.3		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.7			1.6		
BOQ	7.8						7.5			12.4		
QSRatio												
95th Percentile Output:												
fB%	2.0						2.0			1.8		
BOQ	9.2						8.9			14.0		
QSRatio												
98th Percentile Output:												
fB%	2.3						2.3			2.0		
BOQ	10.5						10.2			15.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	69		53				30	554		357	205	
Lane Width	16.0						16.0			16.0		
RTOR Vol	0									17		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	504	1513	0.30	0.33	16.3	B	16.3	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	807	1614	0.81	0.50	20.3	C	20.3	C
----	-----	------	------	------	------	---	------	---

Southbound

TR	918	1835	0.69	0.50	15.4	B	15.4	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	69		53				30	554		357	205	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	22		17				8	156		104	60	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		152						656			634	
%InSharedLn												
Prop LTs		0.566						0.052			0.000	
Prop RTs	0.434						0.000			0.345		
Peds Bikes	0	0		0						0	0	
Buses	0						7			2		
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	69		53				30	554		357	205	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	86		66				34	622		415	219	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		152						656			634	
Prop LTs		0.566						0.052			0.000	
Prop RTs	0.434						0.000			0.345		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.941						1.000			0.953		
fLT	0.972						0.952			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1513						1614			1835		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	152	1513	# 0.10	0.33	504	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	656	1614	# 0.41	0.50	807	0.81
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	634	1835	0.35	0.50	918	0.69
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.30	0.33	14.8	1.000	504	0.50	1.5	0.0	16.3	B	16.3	B
Westbound												
Northbound												
LT	0.81	0.50	12.6	1.000	807	0.50	7.7	0.0	20.3	C	20.3	C
Southbound												
TR	0.69	0.50	11.5	1.000	918	0.50	3.9	0.0	15.4	B	15.4	B

Intersection delay = 17.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		34	
Proportion of LT in LT lane group, PLT	0.566	0.052	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		634	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.57	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.57	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		11.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		9.28	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.56	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.62	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.952	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			9.28	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.309	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		634	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.566		0.052	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.434	0.345
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	12.6	0.00	0.0	0.0	20.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	11.5	0.00	0.0	0.0	15.4
	0.0						0.0	
Intersection Delay			17.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	152						656			634		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1513						1614			1835		
LnCapacity	504						807			918		
Flow Ratio	0.1						0.4			0.3		
v/c Ratio	0.30						0.81			0.69		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.9						9.2			8.1		
kB	0.5						0.6			0.8		
Q2	0.2						2.5			1.6		
Q Average	2.1						11.7			9.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.7						14.1			11.7		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.4			1.4		
BOQ	3.4						16.7			14.0		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.5			1.6		
BOQ	3.8						18.1			15.2		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.7			1.7		
BOQ	4.7						19.8			16.9		
QSRatio												
98th Percentile Output:												
fB%	2.7						1.8			1.9		
BOQ	5.6						21.5			18.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		166	243	465	163	90	199		472	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0			20.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	78.5	E
R	216	1620	0.97	0.13	79.6	E		
Westbound								
LTR	1319	4656	0.75	0.28	22.5	C	22.5	C
Northbound								
L	120	355	0.83	0.33	63.0	E		
T	575	1726	0.38	0.33	17.1	B	31.4	C
Southbound								
TR	662	1985	0.98	0.33	34.6	C	34.6	C

Intersection Delay = 32.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		166	243	465	163	90	199		472	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		53	69	132	46	25	55		155	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		210		989		100	221			649	
%InSharedLn												
Prop LTs					0.279		1.000	0.000			0.000	
Prop RTs			1.000		0.187			0.000			0.043	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds	X	
WB	Left			P			SB	Left		
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds			X				Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		8.0	17.0					20.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		166	243	465	163	90	199		472	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		210	276	528	185	100	221		621	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		210		989		100	221			649	
Prop LTs					0.279		1.000	0.000			0.000	
Prop RTs			1.000		0.187			0.000			0.043	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	R
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.971	0.971	0.971	0.971	0.935	0.935	0.935	0.935
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.972	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.972	0.972		1.000	0.994	0.994
fLT	0.950		0.986	0.986	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1636	1620	4656	4656	355	1726	1985	1985
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	210	1620	# 0.13	0.13	216	0.97
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	989	4656	# 0.21	0.28	1319	0.75
Right							
Northbound							
Prot							
Perm							
Left	L	100	355	0.28	0.33	120	0.83
Prot							
Perm							
Thru	T	221	1726	0.13	0.33	575	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	649	1985	# 0.33	0.33	662	0.98
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.67

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	78.5	E	
R	0.97	0.13	25.9	1.000	216	0.50	53.7	0.0	79.6	E			
Westbound													
LTR	0.75	0.28	19.6	1.000	1319	0.50	2.9	0.0	22.5	C	22.5	C	
Northbound													
L	0.83	0.33	18.5	1.000	120	0.50	44.5	0.0	63.0	E	31.4	C	
T	0.38	0.33	15.3	1.000	575	0.50	1.8	0.0	17.1	B			
Southbound													
TR	0.98	0.33	19.8	1.000	662	0.50	14.8	0.0	34.6	C	34.6	C	

Intersection delay = 32.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			100	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			649	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.67	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.82	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			14.73	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.27	
n=Max(gq-gf)/2,0)			7.37	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.39	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.279 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.73	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.737	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			649	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.187	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	25.9	0.00	0.0	0.0	79.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.6	0.00	0.0	0.0	22.5
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	18.5	0.00	0.0	0.0	63.0
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.8	0.00	0.0	0.0	34.6
	0.0						0.0	
Intersection Delay			32.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	210		363		100	221		649
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1636	1620		1709		355	1726		1985
LnCapacity	218	216		484		120	575		662
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.3
v/c Ratio	0.02	0.97		0.75		0.83	0.38		0.98
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	3.5		5.5		1.5	2.8		10.7
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	2.4		1.1		0.7	0.3		3.2
Q Average	0.1	5.9		6.6		2.2	3.2		13.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.1	7.2		8.0		2.8	4.0		16.8
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.4
BOQ	0.1	8.8		9.7		3.6	4.9		19.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.5
BOQ	0.1	9.7		10.7		4.1	5.6		21.3
QSRatio									
95th Percentile Output:									
fB%	2.6	1.9		1.9		2.2	2.1		1.7
BOQ	0.2	11.2		12.3		5.0	6.7		23.1
QSRatio									
98th Percentile Output:									
fB%	3.2	2.2		2.1		2.7	2.5		1.8
BOQ	0.2	12.7		13.8		6.0	7.9		24.9
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	12	39	11				5	277	98	328	521	32
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 457 1612 0.16 0.28 16.9 B 16.9 B

Westbound

Northbound

LTR 902 1640 0.47 0.55 9.8 A 9.8 A

Southbound

L 496 902 0.83 0.55 19.3 B
 TR 960 1746 0.72 0.55 12.5 B 15.0 B

Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	12	39	11				5	277	98	328	521	32
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	4	11	3				2	77	27	102	163	10
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		73						423		410	691	
%InSharedLn												
Prop LTs		0.192						0.014		1.000	0.000	
Prop RTs		0.178						0.258			0.058	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	12	39	11				5	277	98	328	521	32
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	14	46	13				6	308	109	410	651	40
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	73						423			410	691	
Prop LTs	0.192						0.014			1.000	0.000	
Prop RTs	0.178						0.258			0.058		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.971							0.935			0.935	0.935	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.972			1.000	0.992	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.976							0.965				0.991	
fLT	0.991							0.992			0.508	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1612							1640			902	1746	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	73	1612	# 0.05	0.28	457	0.16
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	423	1640	0.26	0.55	902	0.47
Right							
Southbound							
Prot							
Perm							
Left	L	410	902	# 0.45	0.55	496	0.83
Prot							
Perm							
Thru	TR	691	1746	0.40	0.55	960	0.72
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.16	0.28	16.1	1.000	457	0.50	0.7	0.0	16.9	B	16.9	B
Westbound												
Northbound												
LTR	0.47	0.55	8.2	1.000	902	0.50	1.6	0.0	9.8	A	9.8	A
Southbound												
L	0.83	0.55	11.1	1.000	496	0.50	8.1	0.0	19.3	B		
TR	0.72	0.55	10.1	1.000	960	0.50	2.4	0.0	12.5	B	15.0	B

Intersection delay = 13.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				410
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				423
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				6.83
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.05
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.38
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.62
n=Max(gq-gf)/2,0)				2.19
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.17
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				4.38
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.51
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.508

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		6	
Proportion of LT in LT lane group, PLT	0.192	0.014	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		691	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.10	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.52	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		8.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.14	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.01	
EL1 (refer to Exhibit C16-3)		2.77	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.992	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			8.64	4.38
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.262	0.133
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			691	423
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.014	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.178	0.258	0.058
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.2	0.00	0.0	0.0	9.8
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	11.1	0.00	0.0	0.0	19.3
TR	0.0	0.00	13.5	10.1	0.00	0.0	0.0	12.5
	0.0						0.0	
Intersection Delay			13.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		73						423			410	691
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1612						1640			902	1746
LnCapacity		457						902			496	960
Flow Ratio		0.0						0.3			0.5	0.4
v/c Ratio		0.16						0.47			0.83	0.72
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.941				0.518
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.9						4.3			5.6	8.6
kB		0.5						0.8			0.3	0.4
Q2		0.1						0.7			1.2	1.1
Q Average		1.0						4.9			6.8	9.7
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.2	1.2
BOQ		1.3						6.1			8.3	11.7
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5			1.5	1.4
BOQ		1.7						7.5			10.1	13.9
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.6	1.6
BOQ		1.9						8.3			11.1	15.2
QSRatio												
95th Percentile Output:												
fB%		2.4						2.0			1.9	1.7
BOQ		2.4						9.7			12.6	16.9
QSRatio												
98th Percentile Output:												
fB%		2.9						2.3			2.1	1.9
BOQ		2.9						11.1			14.2	18.5
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	20	13	172	16	104	10	230	131	138	337	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 648 1457 0.09 0.44 14.8 B 14.8 B

Westbound

L 548 1232 0.36 0.44 18.2 B
 T 777 1749 0.02 0.44 14.1 B 17.2 B
 R 574 1291 0.21 0.44 16.1 B

Northbound

LTR 699 1573 0.59 0.44 21.9 C 21.9 C

Southbound

LTR 532 1196 1.20 0.44 115.6 F 115.6 F

Intersection Delay = 62.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	20	13	172	16	104	10	230	131	138	337	9
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	5	49	5	30	3	64	36	45	111	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		60		195	18	118		413			637	
%InSharedLn												
Prop LTs		0.200		1.000	0.000			0.027			0.286	
Prop RTs		0.317			0.000	1.000		0.354			0.019	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000				0.966		0.850			0.090		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5				11.8		18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	20	13	172	16	104	10	230	131	138	337	9
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	12	29	19	195	18	118	11	256	146	182	443	12
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	60			195	18	118	413			637		
Prop LTs	0.200			1.000	0.000		0.027			0.286		
Prop RTs	0.317			0.000 1.000			0.354			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.971			0.952	0.952	0.952	0.935			0.935		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	0.992			1.000	1.000	0.992	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.957				1.000	0.850	0.952			0.997		
fLT	0.968			0.718	1.000		0.982			0.680		
Sec.												
fLpb	1.000			0.948	1.000		1.000			0.992		
fRpb	0.982				1.000	1.000	0.980			1.000		
S	1457			1232	1749	1291	1573			1196		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1457	0.04	0.44	648	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	195	1232	# 0.16	0.44	548	0.36
Prot							
Perm							
Thru	T	18	1749	0.01	0.44	777	0.02
Right	R	118	1291	0.09	0.44	574	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	413	1573	0.26	0.44	699	0.59
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	637	1196	# 0.53	0.44	532	1.20
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	648	0.50	0.3	0.0	14.8	B	14.8	B
Westbound												
L	0.36	0.44	16.5	1.000	548	0.50	1.7	0.0	18.2	B		
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B	17.2	B
R	0.21	0.44	15.3	1.000	574	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.59	0.44	18.8	1.000	699	0.50	3.1	0.0	21.9	C	21.9	C
Southbound												
LTR	1.20	0.44	25.0	1.000	532	0.50	90.6	0.0	115.6	F	115.6	F

Intersection delay = 62.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		195		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.20		
Adjusted opposing flow rate, Vo (veh/h)		60		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		4.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.50		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.80		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.718		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	12	11	182	
Proportion of LT in LT lane group, PLT	0.200	0.000	0.027	0.286
Proportion of LT in opposing flow, PLTo	0.00		0.29	0.03
Adjusted opposing flow rate, Vo (veh/h)	18		637	413
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.30		0.28	4.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45		15.93	10.32
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.6		22.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56		0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00		16.83	10.69
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.43		17.69	29.31
n=Max(gq-gf)/2,0)	0.00		0.00	5.35
PTHo=1-PLTo	1.00		0.71	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.20		0.03	0.29
EL1 (refer to Exhibit C16-3)	1.40		2.63	2.11
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	5.05
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		0.05	0.06
gdifff=max(gq-gf,0)	0.00		0.00	10.69
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97		0.98	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.968		0.982	0.680

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	16.83	10.69
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.421	0.267
OCCpedu	0.000	0.056	0.000	0.049
Opposing flow rate, Vo (veh/h)	18	60	637	413
OCCr	0.000	0.052	0.000	0.027
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.973
Proportion of left turns, PLT	0.200	1.000	0.027	0.286
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.992
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.317	1.000	0.354	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.980	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.8
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	16.5	0.00	0.0	0.0	18.2
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	18.8	0.00	0.0	0.0	21.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	26.2	0.0	115.6
	0.0						0.0	
Intersection Delay			62.0	sec/veh	Intersection LOS		E	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		60	195	18	118		413		637
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	1
SL		1457	1232	1749	1291		1573		1196
LnCapacity		648	548	777	574		699		532
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.5
v/c Ratio		0.09	0.36	0.02	0.21		0.59		1.20
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.9	3.2	0.3	1.8		7.8		15.9
kB		0.8	0.7	0.9	0.7		0.8		0.1
Q2		0.1	0.4	0.0	0.2		1.1		13.5
Q Average		1.0	3.6	0.3	2.0		8.8		29.4
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.2	4.5	0.4	2.5		10.8		35.3
QSRatio									
85th Percentile Output:									
fB%		1.6	1.5	1.7	1.6		1.5		1.4
BOQ		1.6	5.6	0.5	3.2		12.8		41.2
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		1.8	6.3	0.5	3.7		14.0		44.2
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.8		1.6
BOQ		2.3	7.5	0.7	4.5		15.7		47.2
QSRatio									
98th Percentile Output:									
fB%		2.9	2.4	3.1	2.7		2.0		1.7
BOQ		2.8	8.8	0.9	5.4		17.3		50.2
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	175	188		186	217		224		159			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	901	1801	0.39	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	551	1102	0.82	0.50	31.9	C	31.9	C
----	-----	------	------	------	------	---	------	---

Northbound

LR	526	1352	0.77	0.39	33.2	C	33.2	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 27.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		175	188	186	217		224		159			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		48	51	52	61		60		42			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		347			453			407				
%InSharedLn												
Prop LTs		0.000			0.461			0.585				
Prop RTs		0.452			0.000			0.415				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		175	188	186	217		224		159			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		190	157	209	244		238		169			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		347			453			407				
Prop LTs		0.000			0.461			0.585				
Prop RTs		0.452			0.000			0.415				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.939			1.000			0.944					
fLT	1.000			0.578			0.972					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1801			1102			1352					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.39	0.50	13.9	1.000	901	0.50	1.2	0.0	15.1	B	15.1	B
Westbound												
LT	0.82	0.50	19.1	1.000	551	0.50	12.8	0.0	31.9	C	31.9	C
Northbound												
LR	0.77	0.39	24.0	1.000	526	0.50	9.2	0.0	33.2	C	33.2	C
Southbound												

Intersection delay = 27.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	209		
Proportion of LT in LT lane group, PLT	0.000	0.461	0.585
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	347		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.22		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	7.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	37.71		
n=Max(gq-gf)/2,0)	3.65		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.46		
EL1 (refer to Exhibit C16-3)	1.97		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.58		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.578		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	19.1	0.00	0.0	0.0	31.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	24.0	0.00	0.0	0.0	33.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			27.5	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		347			453			407				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1801			1102			1352				
LnCapacity		901			551			526				
Flow Ratio		0.2			0.4			0.3				
v/c Ratio		0.39			0.82			0.77				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.964			0.986			0.858				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.4			9.6			8.9				
kB		1.0			0.7			0.6				
Q2		0.6			2.8			1.9				
Q Average		6.0			12.4			10.8				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		7.4			15.0			13.1				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.4				
BOQ		9.0			17.7			15.5				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.5			1.6				
BOQ		9.9			19.1			16.8				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.7			1.7				
BOQ		11.4			20.9			18.5				
QSRatio												
98th Percentile Output:												
fB%		2.2			1.8			1.9				
BOQ		12.9			22.6			20.2				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	24	17	39	27	19	25	36	259	36	32	278	23
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 229 1963 0.45 0.12 31.0 C 31.0 C

Westbound

LTR 458 1831 0.18 0.25 18.5 B 18.5 B

Northbound

LTR 692 1806 0.56 0.38 17.8 B 17.8 B

Southbound

LTR 642 1675 0.57 0.38 18.2 B 18.2 B

Intersection Delay = 19.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24	17	39	27	19	25	36	259	36	32	278	23
% Heavy Veh	1	1	1	10	10	10	8	8	8	18	18	18
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
PK 15 Vol	8	5	13	8	5	7	11	76	11	9	76	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		103			81			389			365	
%InSharedLn												
Prop LTs		0.301			0.383			0.108			0.096	
Prop RTs		0.485			0.346			0.108			0.068	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			3			3	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	24	17	39	27	19	25	36	259	36	32	278	23
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
Adj flow	31	22	50	31	22	28	42	305	42	35	305	25
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	103			81			389			365		
Prop LTs	0.301			0.383			0.108			0.096		
Prop RTs	0.485			0.346			0.108			0.068		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.990			0.909			0.926			0.847		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.988			0.988		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.934			0.953			0.985			0.991		
fLT	0.985			0.981			0.930			0.938		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1963			1831			1806			1675		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	103	1963	# 0.05	0.12	229	0.45
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	81	1831	# 0.04	0.25	458	0.18
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	389	1806	0.22	0.38	692	0.56
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	365	1675	# 0.22	0.38	642	0.57
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.31
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.42

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.45	0.12	24.7	1.000	229	0.50	6.3	0.0	31.0	C	31.0	C	
Westbound													
LTR	0.18	0.25	17.7	1.000	458	0.50	0.8	0.0	18.5	B	18.5	B	
Northbound													
LTR	0.56	0.38	14.5	1.000	692	0.50	3.3	0.0	17.8	B	17.8	B	
Southbound													
LTR	0.57	0.38	14.6	1.000	642	0.50	3.6	0.0	18.2	B	18.2	B	

Intersection delay = 19.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			42	35
Proportion of LT in LT lane group, PLT	0.301	0.383	0.108	0.096
Proportion of LT in opposing flow, PLTo			0.10	0.11
Adjusted opposing flow rate, Vo (veh/h)			365	389
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.70	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.08	6.48
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.6	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			6.72	7.30
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.28	15.54
n=Max(gq-gf)/2,0)			0.07	0.00
PTHo=1-PLTo			0.90	0.89
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.11	0.10
EL1 (refer to Exhibit C16-3)			2.01	2.06
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.15	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.93	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.930	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.30
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.317
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				389
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.096
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.485	0.108
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.7	0.00	0.0	0.0	31.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.7	0.00	0.0	0.0	18.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.5	0.00	0.0	0.0	17.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.6	0.00	0.0	0.0	18.2
	0.0						0.0	
Intersection Delay			19.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			LTR			LTR			LTR		
Init Queue	0.0			0.0			0.0			0.0		
Flow Rate	103			81			389			365		
So	1900			1900			1900			1900		
No.Lanes	0	1	0	0	1	0	0	1	0	0	1	0
SL	1963			1831			1806			1675		
LnCapacity	229			458			692			642		
Flow Ratio	0.1			0.0			0.2			0.2		
v/c Ratio	0.45			0.18			0.56			0.57		
Grn Ratio	0.12			0.25			0.38			0.38		
I Factor	1.000			1.000			1.000			1.000		
AT or PVG	3			3			3			3		
Pltn Ratio	1.00			1.00			1.00			1.00		
PF2	1.00			1.00			1.00			1.00		
Q1	1.6			1.1			5.1			4.8		
kB	0.3			0.5			0.7			0.6		
Q2	0.2			0.1			0.8			0.8		
Q Average	1.8			1.2			5.9			5.6		
Q Spacing	25.0			25.0			25.0			25.0		
Q Storage	0			0			0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.3			1.2			1.2		
BOQ	2.3			1.5			7.3			6.9		
QSRatio												
85th Percentile Output:												
fB%	1.6			1.6			1.5			1.5		
BOQ	3.0			1.9			8.8			8.4		
QSRatio												
90th Percentile Output:												
fB%	1.8			1.9			1.7			1.7		
BOQ	3.4			2.2			9.8			9.3		
QSRatio												
95th Percentile Output:												
fB%	2.3			2.4			1.9			1.9		
BOQ	4.2			2.8			11.3			10.8		
QSRatio												
98th Percentile Output:												
fB%	2.7			2.9			2.2			2.2		
BOQ	5.1			3.4			12.8			12.3		
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			315	44		20	323	
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91	
Hourly Flow Rate, HFR			370	51		21	354	
Percent Heavy Vehicles			--	--		15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		148		16				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		157		17				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound			
Movement	1		4		7	8	9		10	11	12
Lane Config			LT			LR					
v (vph)			21			174					
C(m) (vph)			1072			371					
v/c			0.02			0.47					
95% queue length			0.06			2.41					
Control Delay			8.4			23.0					
LOS			A			C					
Approach Delay						23.0					
Approach LOS						C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		315	44	20	323	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		93	13	5	89	
Hourly Flow Rate, HFR		370	51	21	354	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	148		16			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	39		4			
Hourly Flow Rate, HFR	157		17			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		354
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		421	792		396			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	396	
Potential Capacity	658	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	658	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	421	
Potential Capacity	1072	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1072	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	792	
Potential Capacity	361	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	354	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 792
Potential Capacity 361
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 354

Results for Two-stage process:

a
y
C t 354

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	157		17			
Movement Capacity (vph)	354		658			
Shared Lane Capacity (vph)		371				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	354		658			
Volume	157		17			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh		371				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		21		174				
C(m) (vph)		1072		371				
v/c		0.02		0.47				
95% queue length		0.06		2.41				
Control Delay		8.4		23.0				
LOS		A		C				
Approach Delay				23.0				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		354
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	299	24	397	1	174	285	241	191	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	712	1710	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	521	1250	0.69	0.42	20.8	C	26.1	C
R	518	1244	0.85	0.42	30.3	C		

Northbound

LTR	710	1703	0.70	0.42	19.8	B	19.8	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	407	976	1.24	0.42	143.2	F	143.2	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 56.3 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	299	24	397	1	174	285	241	191	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	83	7	110	1	47	77	70	56	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			359	441		500			503	
%InSharedLn												
Prop LTs		0.036			0.925			0.002			0.557	
Prop RTs		0.250			0.000	1.000		0.620			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	299	24	397	1	174	285	241	191	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	332	27	441	1	189	310	280	222	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			359 441			500			503		
Prop LTs	0.036			0.925			0.002			0.557		
Prop RTs	0.250			0.000 1.000			0.620			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.916			1.000		
fLT	0.992			0.722			0.999			0.493		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1710			1250 1244			1703			976		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1710	0.02	0.42	712	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	359	1250	0.29	0.42	521	0.69
Right	R	441	1244	# 0.35	0.42	518	0.85
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	500	1703	0.29	0.42	710	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	503	976	# 0.52	0.42	407	1.24
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.87
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.42	10.4	1.000	712	0.50	0.1	0.0	10.5	B	10.5	B	
Westbound													
LT	0.69	0.42	14.3	1.000	521	0.50	6.5	0.0	20.8	C	26.1	C	
R	0.85	0.42	15.8	1.000	518	0.50	14.5	0.0	30.3	C			
Northbound													
LTR	0.70	0.42	14.4	1.000	710	0.50	5.4	0.0	19.8	B	19.8	B	
Southbound													
LTR	1.24	0.42	17.5	1.000	407	0.50	125.7	0.0	143.2	F	143.2	F	

Intersection delay = 56.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	332	1	280
Proportion of LT in LT lane group, PLT	0.036	0.925	0.002	0.557
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.56	0.00
Adjusted opposing flow rate, Vo (veh/h)	359	28	503	500
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.53	0.02	4.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.98	0.47	8.38	8.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.91	0.00	9.10	9.04
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	15.96
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.52
PTHo=1-PLTo	0.08	0.96	0.44	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	0.56
EL1 (refer to Exhibit C16-3)	2.00	1.42	2.31	2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.50
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	9.04
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.722	0.999	0.493

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.91		9.10	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.236		0.364	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	359		503	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	20.8
R	0.0	0.00	17.5	15.8	0.00	0.0	0.0	30.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.4	0.00	0.0	0.0	19.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	24.0	0.0	143.2
	0.0						0.0	
Intersection Delay			56.3	sec/veh	Intersection LOS		E	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	28			359	441	500			503			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1710			1250	1244	1703			976			
LnCapacity	712			521	518	710			407			
Flow Ratio	0.0			0.3	0.4	0.3			0.5			
v/c Ratio	0.04			0.69	0.85	0.70			1.24			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.887		0.931			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.3			4.9	6.6	6.9			8.4			
kB	0.7			0.5	0.5	0.6			0.5			
Q2	0.0			1.0	2.2	1.4			14.0			
Q Average	0.3			5.9	8.9	8.3			22.4			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.4			7.3	10.8	10.1			26.9			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.5	1.5			1.4			
BOQ	0.5			8.8	12.9	12.1			31.5			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.7	1.6	1.6			1.5			
BOQ	0.6			9.8	14.1	13.2			33.8			
QSRatio												
95th Percentile Output:												
fB%	2.5			1.9	1.8	1.8			1.6			
BOQ	0.8			11.3	15.7	14.9			36.1			
QSRatio												
98th Percentile Output:												
fB%	3.1			2.2	2.0	2.0			1.7			
BOQ	0.9			12.8	17.4	16.5			38.5			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				324		3		455			497	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.58 0.33 19.7 B 19.7 B

Northbound

T 970 1940 0.51 0.50 11.7 B 11.7 B

Southbound

T 946 1892 0.61 0.50 12.5 B 12.5 B

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: Philip Habib & Associates
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				324		3	455			497		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				92		1	124			144		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					371		495			578		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				324		3	455			497		
PHF				0.88		0.88	0.92			0.86		
Adj flow				368		3	495			578		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					371			495			578	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	371	1933	# 0.19	0.33	644	0.58
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	495	1940	0.26	0.50	970	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	578	1892	# 0.31	0.50	946	0.61
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.50

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.58	0.33	16.5	1.000	644	0.50	3.2	0.0	19.7	B	19.7	B
Northbound												
T	0.51	0.50	10.1	1.000	970	0.50	1.6	0.0	11.7	B	11.7	B
Southbound												
T	0.61	0.50	10.8	1.000	946	0.50	1.7	0.0	12.5	B	12.5	B

Intersection delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
--	------	------	------	------

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.5	0.00	0.0	0.0	19.7
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.1	0.00	0.0	0.0	11.7
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.8	0.00	0.0	0.0	12.5
	0.0						0.0	
Intersection Delay			14.1	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		455	240			140	681	
Peak-Hour Factor, PHF		0.92	0.92			0.86	0.86	
Hourly Flow Rate, HFR		494	260			162	791	
Percent Heavy Vehicles		--	--			16	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		162						
C(m) (vph)		796						
v/c		0.20						
95% queue length		0.76						
Control Delay		10.7						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		455	240	140	681	
Peak-Hour Factor, PHF		0.92	0.92	0.86	0.86	
Peak-15 Minute Volume		124	65	41	198	
Hourly Flow Rate, HFR		494	260	162	791	
Percent Heavy Vehicles		--	--	16	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		791
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		754						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	754	
Potential Capacity	796	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	796	
Probability of Queue free St.	0.80	1.00
Maj L-Shared Prob Q free St.	0.62	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.62	0.62
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.80	0.80
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.62 0.62
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.80 0.80
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		162						
C(m) (vph)		796						
v/c		0.20						
95% queue length		0.76						
Control Delay		10.7						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.80
v(i1), Volume for stream 2 or 5		791
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.62
d(M,LT), Delay for stream 1 or 4		10.7
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		4.1

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				101		205	478	79		192	471	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 385 1444 0.91 0.27 48.8 D 48.8 D

Northbound

TR 1059 1868 0.57 0.57 10.3 B 10.3 B

Southbound

LT 606 1069 1.27 0.57 142.1 F 142.1 F

Intersection Delay = 76.9 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				101		205	478	79		192	471	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				29		59	130	21		56	137	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					352			606			771	
%InSharedLn												
Prop LTS					0.330			0.000			0.289	
Prop RTS					0.670			0.142			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				101		205	478	79		192	471	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				116		236	520	86		223	548	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					352			606			771	
Prop LTs					0.330			0.000			0.289	
Prop RTs					0.670			0.142			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.909			0.981			1.000	
fLT					0.984			1.000			0.551	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1444			1868			1069	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	352	1444	# 0.24	0.27	385	0.91
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	606	1868	0.32	0.57	1059	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	771	1069	# 0.72	0.57	606	1.27
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.97
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.16

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.91	0.27	21.3	1.000	385	0.50	27.5	0.0	48.8	D	48.8	D
Northbound												
TR	0.57	0.57	8.3	1.000	1059	0.50	2.0	0.0	10.3	B	10.3	B
Southbound												
LT	1.27	0.57	13.0	1.000	606	0.50	129.1	0.0	142.1	F	142.1	F

Intersection delay = 76.9 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			223
Proportion of LT in LT lane group, PLT	0.330	0.000	0.289
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			606
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.72
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			6.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf			27.14
n=Max(gq-gf)/2,0)			3.43
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.29
EL1 (refer to Exhibit C16-3)			2.55
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.55
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.551

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.202
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				606
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.289
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.670	0.142
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.3	0.00	0.0	0.0	48.8
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	41.3	0.0	142.1
	0.0						0.0	
Intersection Delay	76.9	sec/veh			Intersection LOS	E		

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR		LT
Init Queue					0.0		0.0		0.0
Flow Rate					352		606		771
So					1900		1900		1900
No.Lanes	0	0	0	0	0	0	1	0	1
SL					1444		1868		1069
LnCapacity					385		1059		606
Flow Ratio					0.2		0.3		0.7
v/c Ratio					0.91		0.57		1.27
Grn Ratio					0.27		0.57		0.57
I Factor					0.944		0.880		0.500
AT or PVG					3		3		3
Pltn Ratio					1.00		1.00		1.00
PF2					1.00		1.00		1.00
Q1					5.7		6.5		12.9
kB					0.4		0.8		0.3
Q2					2.7		1.0		22.0
Q Average					8.4		7.5		34.8
Q Spacing					25.0		25.0		25.0
Q Storage					0		0		0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2		1.2
BOQ					10.2		9.2		41.8
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5		1.4
BOQ					12.2		11.0		48.7
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6		1.5
BOQ					13.4		12.1		52.2
QSRatio									
95th Percentile Output:									
fB%					1.8		1.8		1.6
BOQ					15.0		13.7		55.7
QSRatio									
98th Percentile Output:									
fB%					2.0		2.0		1.7
BOQ					16.6		15.3		59.2
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	144	65	92	39	176	73	106	604	136	122	483	70
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	420	1220	0.83	0.34	39.1	D	39.1	D
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	548	1592	0.57	0.34	28.3	C	28.3	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	305	560	0.38	0.54	14.4	B		
TR	1052	1932	0.77	0.54	20.2	C	19.5	B

Southbound

LTR	867	1593	0.86	0.54	27.9	C	27.9	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 26.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	144	65	92	39	176	73	106	604	136	122	483	70
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	42	19	27	11	48	20	29	166	37	34	136	20
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		350			312		116	813			743	
%InSharedLn												
Prop LTs		0.477			0.135		1.000	0.000			0.184	
Prop RTs		0.306			0.253			0.183			0.085	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	144	65	92	39	176	73	106	604	136	122	483	70
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	167	76	107	42	191	79	116	664	149	137	543	63
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	350			312			116 813			743		
Prop LTs	0.477			0.135			1.000 0.000			0.184		
Prop RTs	0.306			0.253			0.183			0.085		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.959			0.966			0.973			0.987		
fLT	0.609			0.920			0.322 1.000			0.531		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1220			1592			560 1932			1593		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	350	1220	# 0.29	0.34	420	0.83
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	312	1592	0.20	0.34	548	0.57
Right							
Northbound							
Prot							
Perm							
Left	L	116	560	0.21	0.54	305	0.38
Prot							
Perm							
Thru	TR	813	1932	0.42	0.54	1052	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	743	1593	# 0.47	0.54	867	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.75
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.83	0.34	27.1	1.000	420	0.50	12.0	0.0	39.1	D	39.1	D
Westbound												
LTR	0.57	0.34	24.1	1.000	548	0.50	4.2	0.0	28.3	C	28.3	C
Northbound												
L	0.38	0.54	11.8	1.000	305	0.50	2.6	0.0	14.4	B		
TR	0.77	0.54	16.1	1.000	1052	0.50	4.1	0.0	20.2	C	19.5	B
Southbound												
LTR	0.86	0.54	17.5	1.000	867	0.50	10.4	0.0	27.9	C	27.9	C

Intersection delay = 26.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			116	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.18	
Adjusted opposing flow rate, Vo (veh/h)			743	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.90	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.76	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			6.35	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.65	
n=Max(gq-gf)/2,0)			3.17	
PTHo=1-PLTo			0.82	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.70	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.58	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			6.35	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.32	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.322	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	167	42	137
Proportion of LT in LT lane group, PLT	0.477	0.135	0.000
Proportion of LT in opposing flow, PLTo	0.13	0.48	0.00
Adjusted opposing flow rate, Vo (veh/h)	312	350	813
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	4.18	1.05	3.43
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.80	8.75	20.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	0.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	10.11	11.49	28.77
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.89	19.51	20.23
n=Max(gq-gf)/2,0)	5.05	1.86	13.98
PTHo=1-PLTo	0.87	0.52	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.48	0.13	0.97
EL1 (refer to Exhibit C16-3)	1.90	1.98	3.12
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.85	1.47	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.07	0.08
gdifff=max(gq-gf,0)	10.11	3.72	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.61	0.92	0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.609	0.920	0.531

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	10.11	11.49	6.35	28.77
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.326	0.371	0.130	0.587
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	312	350	743	813
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.477	0.135	1.000	0.184
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.306	0.253	0.183	0.085
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	27.1	0.00	0.0	0.0	39.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	24.1	0.00	0.0	0.0	28.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	11.8	0.00	0.0	0.0	14.4
TR	0.0	0.00	20.5	16.1	0.00	0.0	0.0	20.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	17.5	0.00	0.0	0.0	27.9
	0.0						0.0	
Intersection Delay			26.3	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	350		312		116	813	390	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 0	1 0	0	1 1 0	0 0	2 0	
SL	1220		1592		560	1932	836	
LnCapacity	420		548		305	1052	455	
Flow Ratio	0.3		0.2		0.2	0.4	0.5	
v/c Ratio	0.83		0.57		0.38	0.77	0.86	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	8.0		6.4		1.7	16.0	8.3	
kB	0.4		0.8		0.4	0.9	0.6	
Q2	1.7		1.0		0.2	2.7	2.8	
Q Average	9.7		7.3		1.9	18.7	11.2	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	11.8		9.0		2.4	22.5	13.5	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.5		1.6	1.4	1.4	
BOQ	14.1		10.8		3.0	26.3	16.0	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.8	1.5	1.6	
BOQ	15.3		11.8		3.5	28.3	17.4	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.8		2.3	1.6	1.7	
BOQ	17.0		13.4		4.3	30.3	19.1	
QSRatio								
98th Percentile Output:								
fB%	1.9		2.0		2.7	1.7	1.9	
BOQ	18.6		15.0		5.1	32.4	20.8	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	291						821			585		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	662	1986	0.50	0.33	26.7	C	26.7	C

Westbound

Northbound

T 2134 3842 0.42 0.56 12.1 B 12.1 B

Southbound

T 1951 3512 0.34 0.56 11.4 B 11.4 B

Intersection Delay = 14.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	291						821			585		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	83						226			164		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	331						902			657		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	291						821			585		
PHF	0.88						0.91			0.89		
Adj flow	331						902			657		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	331						902			657		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.971						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	1986						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	331	1986	# 0.17	0.33	662	0.50
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	902	3842	# 0.23	0.56	2134	0.42
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	657	3512	0.19	0.56	1951	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.45

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.50	0.33	24.0	1.000	662	0.50	2.7	0.0	26.7	C	26.7	C	
Westbound													
Northbound													
T	0.42	0.56	11.6	1.000	2134	0.50	0.5	0.0	12.1	B	12.1	B	
Southbound													
T	0.34	0.56	10.9	1.000	1951	0.50	0.5	0.0	11.4	B	11.4	B	

Intersection delay = 14.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	331						473		345	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.50						0.42		0.34	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.6						6.9		4.7	
kB	0.9						0.9		1.1	
Q2	0.8						0.7		0.6	
Q Average	7.5						7.5		5.3	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	9.1						9.2		6.5	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	10.9						11.0		8.0	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	12.0						12.1		8.8	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		1.9	
BOQ	13.6						13.7		10.3	
QSRatio										
98th Percentile Output:										
fB%	2.0						2.0		2.2	
BOQ	15.2						15.3		11.7	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year:
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume						585		
Peak-Hour Factor, PHF						0.89		
Hourly Flow Rate, HFR						657		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Raised curb / 1						
RT Channelized?								
Lanes						2		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume						90		
Peak Hour Factor, PHF						0.84		
Hourly Flow Rate, HFR						107		
Percent Heavy Vehicles						29		
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage		/					/	
Lanes						1		
Configuration						R		

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config								R		

v (vph)								107	
C(m) (vph)								655	
v/c								0.16	
95% queue length								0.58	
Control Delay								11.6	
LOS								B	
Approach Delay							11.6		
Approach LOS							B		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year:
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					585	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					164	
Hourly Flow Rate, HFR					657	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						90
Peak Hour Factor, PHF						0.84
Peak-15 Minute Volume						27
Hourly Flow Rate, HFR						107
Percent Heavy Vehicles						29
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								328
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		328
Potential Capacity		655
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		655
Probability of Queue free St.	1.00	0.84
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	465
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	465
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	465	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	465	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	519
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	519

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	734	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity	614	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						107
Movement Capacity (vph)						655
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						655
Volume						107
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								107
C(m) (vph)								655
v/c								0.16
95% queue length								0.58
Control Delay								11.6
LOS								B
Approach Delay							11.6	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Conditions

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	149	326	152	215	600	84	157	326	223	149	67	89
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	136	409	1.30	0.33	203.8	F		
TR	602	1805	0.88	0.33	43.3	D	83.4	F
Westbound								
L	86	257	2.78	0.33	859.8	F		
TR	1120	3359	0.67	0.33	28.6	C	230.3	F
Northbound								
LTR	926	3332	0.82	0.28	38.5	D	38.5	D
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	353	1590	0.55	0.22	37.1	D	36.0	D

Intersection Delay = 116.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	326	152	215	600	84	157	326	223	149	67	89
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	97	45	60	167	23	42	88	60	47	21	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	177	531		239	746			760		186	195	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.222			0.000	
Prop RTs		0.269			0.106			0.316			0.569	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	326	152	215	600	84	157	326	223	149	67	89
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	177	388	143	239	667	79	169	351	240	186	84	111
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	177	531		239	746		760			186	195	
Prop LTs	1.000	0.000		1.000	0.000		0.222			0.000		
Prop RTs	0.269			0.106			0.316			0.569		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.943	0.943		0.962			0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.960			0.984		0.953				0.915	
fLT	0.225	1.000		0.154	1.000		0.989			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	409	1805		257	3359		3332			1711	1590	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	177	409	0.43	0.33	136	1.30
Prot							
Perm							
Thru	TR	531	1805	0.29	0.33	602	0.88
Right							
Westbound							
Prot							
Perm							
Left	L	239	257	# 0.93	0.33	86	2.78
Prot							
Perm							
Thru	TR	746	3359	0.22	0.33	1120	0.67
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	760	3332	# 0.23	0.28	926	0.82
Right							
Southbound							
Prot							
Perm							
Left	L	186	1711	0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	195	1590	# 0.12	0.22	353	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.28
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.54

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.30	0.33	30.0	1.000	136	0.50	173.8	0.0	203.8	F			
TR	0.88	0.33	28.3	1.000	602	0.50	14.9	0.0	43.3	D	83.4	F	
Westbound													
L	2.78	0.33	30.0	1.000	86	0.50	829.8	0.0	859.8	F			
TR	0.67	0.33	25.7	1.000	1120	0.50	2.9	0.0	28.6	C	230.3	F	
Northbound													
LTR	0.82	0.28	30.4	1.000	926	0.50	8.1	0.0	38.5	D	38.5	D	
Southbound													
L	0.49	0.22	30.5	1.000	380	0.50	4.4	0.0	34.9	C			
TR	0.55	0.22	31.0	1.000	353	0.50	6.0	0.0	37.1	D	36.0	D	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.222 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	11.69			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.390			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	746			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	10.3	0.0	203.8
TR	0.0	0.00	30.0	28.3	0.00	0.0	0.0	43.3
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	38.2	0.0	859.8
TR	0.0	0.00	30.0	25.7	0.00	0.0	0.0	28.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	30.4	0.00	0.0	0.0	38.5
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	31.0	0.00	0.0	0.0	37.1
	0.0						0.0	

Intersection Delay	116.0	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	177	531		239	391		399			186	195	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	409	1805		257	1764		1749			1711	1590	
LnCapacity	136	602		86	588		486			380	353	
Flow Ratio	0.4	0.3		0.9	0.2		0.2			0.1	0.1	
v/c Ratio	1.30	0.88		2.78	0.66		0.82			0.49	0.55	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.4	12.5		6.0	8.4		9.3			4.1	4.3	
kB	0.2	0.7		0.2	0.7		0.7			0.6	0.5	
Q2	6.0	3.6		19.4	1.4		2.6			0.5	0.6	
Q Average	10.4	16.2		25.4	9.7		11.9			4.6	5.0	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	12.7	19.5		30.5	11.8		14.4			5.7	6.1	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.4			1.5	1.5	
BOQ	15.0	22.8		35.6	14.1		17.0			7.0	7.5	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.5	1.6		1.5			1.7	1.7	
BOQ	16.3	24.6		38.2	15.3		18.4			7.8	8.4	
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.6	1.7		1.7			2.0	2.0	
BOQ	18.0	26.5		40.8	17.0		20.1			9.2	9.8	
QSRatio												
98th Percentile Output:												
fB%	1.9	1.8		1.7	1.9		1.8			2.3	2.3	
BOQ	19.7	28.4		43.4	18.6		21.9			10.6	11.2	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						434			
Peak-Hour Factor, PHF						0.87			
Hourly Flow Rate, HFR						498			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		133							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		143							
Percent Heavy Vehicles		4							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/			/	
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			143							
C(m) (vph)			528							
v/c			0.27							
95% queue length			1.09							
Control Delay			14.3							
LOS			B							
Approach Delay				14.3						
Approach LOS				B						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 434
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 125
 Hourly Flow Rate, HFR 498
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 133
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 36
 Hourly Flow Rate, HFR 143
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			498					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	498	
Potential Capacity	528	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	528	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 498
Potential Capacity 528
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 528

Results for Two-stage process:
a
y
C t 528

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	143					
Movement Capacity (vph)	528					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	528					
Volume	143					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			143					
C(m) (vph)			528					
v/c			0.27					
95% queue length			1.09					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Bricktown Way/Tyrellan Ave
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	128	60	130	149	172	44	41	41	78	188	58
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.88	0.88	0.90	0.90	0.78	0.78	1.00	1.00
Flow Rate	89	140	226	274	108	52	172	152
% Heavy Veh	42	42	4	4	3	3	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	89	140	226	274	108	52	172	152
Left-Turn	17	0	144	0	56	0	78	0
Right-Turn	0	68	0	191	0	52	0	58
Prop. Left-Turns	0.2	0.0	0.6	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.5	0.0	0.7	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.8	0.4	0.4	-0.4	0.3	-0.6	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	89	140	226	274	108	52	172	152
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.08	0.12	0.20	0.24	0.10	0.05	0.15	0.14
hd, final value	7.52	7.08	6.75	5.95	7.36	6.40	7.00	6.50
x, final value	0.19	0.28	0.42	0.45	0.22	0.09	0.33	0.27
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.2	4.8	4.5	3.6	5.1	4.1	4.7	4.2

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	89	140	226	274	108	52	172	152
Service Time	5.2	4.8	4.5	3.6	5.1	4.1	4.7	4.2
Utilization, x	0.19	0.28	0.42	0.45	0.22	0.09	0.33	0.27
Dep. headway, hd	7.52	7.08	6.75	5.95	7.36	6.40	7.00	6.50
Capacity	339	390	476	524	358	302	422	402
Delay	11.93	12.46	14.33	13.47	12.13	9.75	13.17	11.65
LOS	B	B	B	B	B	A	B	B
Approach:								
Delay	12.25		13.86		11.36		12.46	
LOS	B		B		B		B	
Intersection Delay	12.85		Intersection LOS		B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	62	133	476	225	382	18	296	200	88	23	527	225
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 806 3155 0.99 0.26 61.3 E 61.3 E

Westbound

LTR 878 3435 0.79 0.26 38.0 D 38.0 D

Northbound

DefL 94 292 3.62 0.32 1234 F
 TR 586 1819 0.56 0.32 29.2 C 639.7 F

Southbound

LTR 854 2650 1.01 0.32 63.6 E 63.6 E

Intersection Delay = 184.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	133	476	225	382	18	296	200	88	23	527	225
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	40	142	63	106	5	85	57	25	6	146	63
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		799			694		340	331			862	
%InSharedLn												
Prop LTs		0.093			0.360		1.000	0.000			0.030	
Prop RTs		0.710			0.029			0.305			0.290	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	133	476	225	382	18	296	200	88	23	527	225
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	74	158	567	250	424	20	340	230	101	26	586	250
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	799			694			340 331			862		
Prop LTs	0.093			0.360			1.000 0.000			0.030		
Prop RTs	0.710			0.029			0.305			0.290		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.894			0.996			0.954			0.956		
fLT	0.995			0.982			0.153 1.000			0.936		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3155			3435			292 1819			2650		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	799	3155	# 0.25	0.26	806	0.99
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	694	3435	# 0.20	0.26	878	0.79
Right							
Northbound							
Prot							
Perm							
Left	DefL	340	292	# 1.16	0.32	94	3.62
Prot							
Perm							
Thru	TR	331	1819	0.18	0.32	586	0.56
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	862	2650	0.33	0.32	854	1.01
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.62
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.94

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.99	0.26	33.4	1.000	806	0.50	27.9	0.0	61.3	E	61.3	E	
Westbound													
LTR	0.79	0.26	31.3	1.000	878	0.50	6.7	0.0	38.0	D	38.0	D	
Northbound													
DefL	3.62	0.32	30.5	1.000	94	0.50	1204	0.0	1234	F			
TR	0.56	0.32	25.3	1.000	586	0.50	3.9	0.0	29.2	C	639.7	F	
Southbound													
LTR	1.01	0.32	30.5	1.000	854	0.50	33.1	0.0	63.6	E	63.6	E	

Intersection delay = 184.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			340	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			862	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			8.50	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.32	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			15.50	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			13.50	
n=Max(gq-gf)/2,0)			7.75	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.04	
EL2=Max((1-Ptho*n)/Plto, 1.0)			7.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			15.50	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.15	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.153	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	26
Proportion of LT in LT lane group, PLT	0.093 0.360 0.000 0.030
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	331
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.65
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.14
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	1.18
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.82
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07
EL1 (refer to Exhibit C16-3)	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.936

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				1.18
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.041
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				331
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.030
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.710	0.029	0.305
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.4	0.00	0.0	0.0	61.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	31.3	0.00	0.0	0.0	38.0
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	61.5	0.0	1234
TR	0.0	0.00	30.5	25.3	0.00	0.0	0.0	29.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.5	0.00	2.0	0.0	63.6
	0.0						0.0	
Intersection Delay			184.9	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	419		364		340	331	452	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	2 0	0 0	0 2 0	0 0	2 0	0 0
SL	1657		1804		292	1819	1391	
LnCapacity	423		461		94	586	448	
Flow Ratio	0.3		0.2		1.2	0.2	0.3	
v/c Ratio	0.99		0.79		3.62	0.56	1.01	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.889		0.932			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	10.4		8.5		8.5	6.9	11.3	
kB	0.6		0.6		0.2	0.8	0.7	
Q2	5.2		2.0		31.0	1.0	6.3	
Q Average	15.6		10.5		39.5	7.8	17.6	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	18.8		12.7		47.5	9.6	21.2	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.4	
BOQ	22.0		15.1		55.4	11.5	24.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.6		1.5	1.6	1.5	
BOQ	23.7		16.4		59.3	12.6	26.7	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.7		1.6	1.8	1.6	
BOQ	25.6		18.1		63.3	14.2	28.7	
QSRatio								
98th Percentile Output:								
fB%	1.8		1.9		1.7	2.0	1.7	
BOQ	27.5		19.8		67.3	15.8	30.7	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Conditions

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	678	430	3	1	449	796	0	0	1	125	0	136
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	783	1711	0.95	0.71	33.9	C		
TR	1158	1628	0.41	0.71	6.1	A	23.1	C
Westbound								
LT	451	1843	1.07	0.24	86.8	F	427.9	F
R	383	1568	2.28	0.24	616.6	F		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.55	0.18	42.9	D		
LT	320	1801	0.00	0.18	30.4	C	24.0	C
R	952	1478	0.15	0.64	6.6	A		

Intersection Delay = 216.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	678	430	3	1	449	796	0	0	1	125	0	136
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	186	118	1	1	121	219	0	0	1	32	0	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	745	476			484	875		4		129	0	140
%InSharedLn										0		
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.006			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0		0		0			0		0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	678	430	3	1	449	796	0	0	1	125	0	136
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	745	473	3	1	483	875	0	0	4	129	0	140
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	745	476			484	875		4		129	0	140
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.006			0.000	1.000		1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.980	0.980		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.865				1.000	0.850
fLT	0.950	1.000		0.999			1.000			0.755	1.000	
Sec.	0.148											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1711	1628		1843	1568		1844			1313	1801	1478
Sec.	267											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		703	1711	# 0.41	0.411	703	1.00
Perm		42	267	0.16	0.300	80	0.52
Left	L	745			0.71	783	0.95
Prot							
Perm							
Thru	TR	476	1628	0.29	0.71	1158	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1843	0.26	0.24	451	1.07
Right	R	875	1568	# 0.56	0.24	383	2.28
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	129	1313	# 0.10	0.18	233	0.55
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	140	1478	0.09	0.64	952	0.15

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.07
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.95	0.71	15.8	1.000	783	0.50	18.1	0.0	33.9	C			
TR	0.41	0.71	5.3	1.000	1158	0.50	0.8	0.0	6.1	A	23.1	C	
Westbound													
LT	1.07	0.24	34.0	1.000	451	0.50	52.8	0.0	86.8	F	427.9	F	
R	2.28	0.24	34.0	1.000	383	0.50	582.6	0.0	616.6	F			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.55	0.18	33.7	1.000	233	0.50	9.2	0.0	42.9	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	24.0	C	

R 0.15 0.64 6.3 1.000 952 0.50 0.3 0.0 6.6 A

Intersection delay = 216.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	745			129
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	484			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.63			3.23
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.10			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	25.01			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	1.99			16.00
n=Max(gq-gf)/2,0)	12.50			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.05			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	12.36			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	25.01			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	476	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.90	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		2.25	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdif=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		476		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.006
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	745			
v/c ratio from Capacity Worksheet, X	0.95			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	21.01			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	28.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.86			
XPerm	1.51			
XProt	0.76			
Case	3			
Queue at beginning of green arrow, Qa	7.54			
Queue at beginning of unsaturated green, Qu	4.35			
Residual queue, Qr	1.75			
Uniform Delay, d1	15.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		15.8	0.00	0.0	0.0	33.9
TR	0.0	0.00	13.0	5.3	0.00	0.0	0.0	6.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	34.0	0.00	8.3	0.0	86.8
R	0.0	0.00	34.0	34.0	0.00	123.0	0.0	616.6
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.9
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.6
Intersection Delay			216.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	745	476		484	875	4		129	0	140
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1102	1628		1843	1568	1844		1313	1801	1478
LnCapacity	783	1158		451	383	328		233	320	952
Flow Ratio	0.7	0.3		0.3	0.6	0.0		0.1	0.0	0.1
v/c Ratio	0.95	0.41		1.07	2.28	0.01		0.55	0.00	0.15
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	8.8	4.9		12.1	21.9	0.1		2.9	0.0	1.4
kB	0.7	0.9		0.4	0.3	0.5		0.4	0.5	1.1
Q2	6.1	0.6		7.1	62.1	0.0		0.5	0.0	0.2
Q Average	14.9	5.5		19.2	83.9	0.1		3.4	0.0	1.6
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	18.0	6.8		23.1	101	0.1		4.3	0.0	2.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4	1.7		1.6	1.7	1.6
BOQ	21.1	8.3		27.1	118	0.2		5.3	0.0	2.5
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5	2.0		1.8	2.0	1.9
BOQ	22.8	9.2		29.1	126	0.2		6.0	0.0	2.9
QSRatio										
95th Percentile Output:										
fB%	1.7	1.9		1.6	1.6	2.6		2.1	2.6	2.3
BOQ	24.6	10.6		31.2	134	0.2		7.2	0.0	3.6
QSRatio										
98th Percentile Output:										
fB%	1.8	2.2		1.7	1.7	3.2		2.5	3.2	2.8
BOQ	26.5	12.1		33.3	143	0.3		8.4	0.0	4.4
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/13	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2020 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	707	1413	0.81	0.50	28.1	C		
TR	1056	2111	0.04	0.50	11.5	B	26.9	C

LTR	1536	3071	0.09	0.50	11.9	B	11.9	B
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Northbound								
DefL	517	1329	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	539	1386	0.14	0.39	18.3	B	293.6	F
R	593	1524	1.63	0.39	315.9	F		

Intersection Delay = 180.4 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	143	10	0	1	18	20	2	1	0	18	2	327
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	570	42			131		7	5			78	964
%InSharedLn												
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0	0	0	0	
Buses	0	0			0		0	0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	519	38	0	2	64	71	4	3	0	64	6	1178
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	570	42	0	2	70	59	7	5	0	71	7	964
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	570	42			131		7	5			78	964
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.932				1.000		1.000	0.850	
fLT	0.669	1.000		0.954			0.706	1.000		0.773		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1413	2111		3071			1329	1881		1386	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	570	1413	# 0.40	0.50	707	0.81
Prot							
Perm							
Thru	TR	42	2111	0.02	0.50	1056	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	131	3071	0.04	0.50	1536	0.09
Right							
Northbound							
Prot							
Perm							
Left	DefL	7	1329	0.01	0.39	517	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	78	1386	0.06	0.39	539	0.14
Right	R	964	1524	# 0.63	0.39	593	1.63

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.04$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.17$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.81	0.50	18.8	1.000	707	0.50	9.2	0.0	28.1	C		
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	26.9	C
Westbound												
LTR	0.09	0.50	11.8	1.000	1536	0.50	0.1	0.0	11.9	B	11.9	B
Northbound												
DefL	0.01	0.39	16.9	1.000	517	0.50	0.0	0.0	16.9	B		
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.14	0.39	17.8	1.000	539	0.50	0.5	0.0	18.3	B	293.6	F

R 1.63 0.39 27.5 1.000 593 0.50 288.4 0.0 315.9 F

Intersection delay = 180.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	570		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	131		78	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/3600	14.25		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.72		1.95	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.42	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.669		0.706	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gfgq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	71
Proportion of LT in LT lane group, PLT	0.000	0.015 0.000 0.910
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	42	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.78
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.52	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.75
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	131	42	78	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.015	1.000	0.910
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.450	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	18.8	0.00	0.0	0.0	28.1
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	27.5	27.5	0.00	92.8	0.0	315.9
Intersection Delay			180.4	sec/veh	Intersection LOS F			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	570	42			68		7	5		78	964	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1413	2111			1612		1329	1881		1386	1524	
LnCapacity	707	1056			806		517	732		539	593	
Flow Ratio	0.4	0.0			0.0		0.0	0.0		0.1	0.6	
v/c Ratio	0.81	0.04			0.08		0.01	0.01		0.14	1.63	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	11.9	0.5			0.9		0.1	0.1		1.3	24.1	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	3.0	0.0			0.1		0.0	0.0		0.1	48.1	
Q Average	15.0	0.6			1.0		0.1	0.1		1.4	72.2	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	18.1	0.8			1.3		0.2	0.1		1.8	86.7	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	21.2	1.0			1.6		0.2	0.1		2.2	101	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	22.8	1.1			1.9		0.2	0.2		2.6	108	
QSRatio												
95th Percentile Output:												
fB%	1.6	2.5			2.4		2.6	2.6		2.4	1.6	
BOQ	24.7	1.5			2.4		0.3	0.2		3.2	116	
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			2.9		3.2	3.2		2.8	1.7	
BOQ	26.6	1.8			2.9		0.4	0.3		3.9	123	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	264		25				4	239		601	616	
Lane Width	13.0		12.0					11.5		16.0		
RTOR Vol			6								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.56	0.32	21.1	C	20.6	C
R	465	1468	0.05	0.32	14.4	B		
Westbound								

Northbound

LT 1651 3195 0.16 0.52 7.9 A 7.9 A

Southbound

TR 1919 3714 0.79 0.52 14.3 B 14.3 B

Intersection Delay = 14.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	264		25				4	239		601	616	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	75		7				1	66		188	192	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	300		22					270			1521	
%InSharedLn												
Prop LTs								0.015			0.000	
Prop RTs			1.000					0.000			0.506	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975					0.998			0.686		
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	264		25				4	239		601	616	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	300		22				4	266		751	770	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	300		22					270			1521	
Prop LTs								0.015			0.000	
Prop RTs			1.000					0.000			0.506	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.909	0.909			0.962		0.980	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.924	
fLT	0.950				0.934		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1696	1468			3195		3714	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	300	1696	# 0.18	0.32	537	0.56
Prot							
Perm							
Thru							
Right	R	22	1468	0.01	0.32	465	0.05
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	270	3195	0.08	0.52	1651	0.16
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1521	3714	# 0.41	0.52	1919	0.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.59
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.56	0.32	17.0	1.000	537	0.50	4.1	0.0	21.1	C	20.6	C
R	0.05	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B		
Westbound												
Northbound												
LT	0.16	0.52	7.7	1.000	1651	0.50	0.2	0.0	7.9	A	7.9	A
Southbound												
TR	0.79	0.52	11.9	1.000	1919	0.50	2.4	0.0	14.3	B	14.3	B

Intersection delay = 14.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.015 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1521
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.31
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	18.14
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	6.57
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.934

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			18.14	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.585	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1521	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.015	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.506
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	17.0	0.00	0.0	0.0	21.1
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	7.9
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.9	0.00	0.0	0.0	14.3
	0.0						0.0	
Intersection Delay			14.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	300	22				141		798	
So	1900	1900				1900		1900	
No.Lanes	1 0	1 0	0 0 0			2 0		2 0	
SL	1696	1468				1678		1950	
LnCapacity	537	465				867		1007	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.56	0.05				0.16		0.79	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	4.2	0.3				1.2		10.9	
kB	0.5	0.5				0.8		0.6	
Q2	0.7	0.0				0.2		2.1	
Q Average	4.8	0.3				1.4		13.0	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	6.0	0.4				1.8		15.7	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	7.3	0.5				2.3		18.5	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.5	
BOQ	8.2	0.5				2.6		20.0	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.5				2.4		1.7	
BOQ	9.6	0.7				3.3		21.7	
QSRatio									
98th Percentile Output:									
fB%	2.3	3.1				2.8		1.8	
BOQ	11.0	0.9				3.9		23.5	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	38	0		550	83		1			23	666	34
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.19	0.42	11.7	B	11.7	B
----	-----	------	------	------	------	---	------	---

Westbound

L	521	1250	1.11	0.42	90.8	F		
T	810	1944	0.11	0.42	10.9	B	80.3	F

Northbound

L	175	420	0.01	0.42	10.3	B	10.3	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2026	4863	0.45	0.42	13.2	B	13.2	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 39.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		38	0	550	83		1			23	666	34
% Heavy Veh		1	1	1	1		1			2	2	2
PHF		0.25	0.25	0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol		38	0	145	22		1			7	208	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		152		579	87		1				903	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.032	
Prop RTs		0.000			0.000						0.047	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.983			0.989		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	38	0		550	83		1			23	666	34
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	152	0		579	87		1			29	832	42
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	152			579	87		1			903		
Prop LTs	0.000			1.000	0.000		1.000			0.032		
Prop RTs	0.000			0.000						0.047		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.993	
fLT	1.000		0.643 1.000		0.239		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1250 1944		420		4863	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	152	1881	0.08	0.42	784	0.19
Right							
Westbound							
Prot							
Perm							
Left	L	579	1250	# 0.46	0.42	521	1.11
Prot							
Perm							
Thru	T	87	1944	0.04	0.42	810	0.11
Right							
Northbound							
Prot							
Perm							
Left	L	1	420	0.00	0.42	175	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	903	4863	# 0.19	0.42	2026	0.45
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.19	0.42	11.1	1.000	784	0.50	0.6	0.0	11.7	B	11.7	B	
Westbound													
L	1.11	0.42	17.5	1.000	521	0.50	73.3	0.0	90.8	F			
T	0.11	0.42	10.7	1.000	810	0.50	0.3	0.0	10.9	B	80.3	F	
Northbound													
L	0.01	0.42	10.2	1.000	175	0.50	0.1	0.0	10.3	B	10.3	B	
Southbound													
LTR	0.45	0.42	12.5	1.000	2026	0.50	0.7	0.0	13.2	B	13.2	B	

Intersection delay = 39.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		579	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		152	903	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		9.65	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		2.53	5.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.67	5.26	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		24.33	19.74	
n=Max(gq-gf)/2,0)		0.33	2.63	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.51	3.30	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.56	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	5.26	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.64	0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.643	0.239	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.032
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 0.908
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	T	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	152		579	87	1		331	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1250	1944	420		1785	
LnCapacity	784		521	810	175		743	
Flow Ratio	0.1		0.5	0.0	0.0		0.2	
v/c Ratio	0.19		1.11	0.11	0.01		0.45	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.983		0.989	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	1.6		9.6	0.9	0.0		4.0	
kB	0.7		0.5	0.7	0.3		0.7	
Q2	0.2		10.8	0.1	0.0		0.6	
Q Average	1.8		20.5	1.0	0.0		4.5	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	2.3		24.6	1.2	0.0		5.6	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.4	1.6	1.7		1.5	
BOQ	2.9		28.8	1.6	0.0		6.9	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.5	1.9	2.0		1.7	
BOQ	3.3		30.9	1.9	0.0		7.7	
QSRatio								
95th Percentile Output:								
fB%	2.3		1.6	2.4	2.6		2.0	
BOQ	4.1		33.1	2.4	0.0		9.0	
QSRatio								
98th Percentile Output:								
fB%	2.8		1.7	2.9	3.2		2.3	
BOQ	4.9		35.3	2.9	0.0		10.4	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year:
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1 L	2 T	3 R	4 L	5 T	6 R		

Volume	38
Peak-Hour Factor, PHF	0.55
Hourly Flow Rate, HFR	69
Percent Heavy Vehicles	-- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound				Southbound			
		7 L	8 T	9 R	10 L	11 T	12 R		

Volume	502
Peak Hour Factor, PHF	0.90
Hourly Flow Rate, HFR	557
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound				Southbound			
	1	4	7	8	9	10	11	12		

v (vph)	557
C(m) (vph)	997
v/c	0.56
95% queue length	3.57
Control Delay	13.1
LOS	B
Approach Delay	13.1
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year:
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		38				
Peak-Hour Factor, PHF		0.55				
Peak-15 Minute Volume		17				
Hourly Flow Rate, HFR		69				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			502			
Peak Hour Factor, PHF			0.90			
Peak-15 Minute Volume			139			
Hourly Flow Rate, HFR			557			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					69			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	69	
Potential Capacity	997	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	997	
Probability of Queue free St.	0.44	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.44
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.44
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			557			
Movement Capacity (vph)			997			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			997			
Volume			557			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					557			
C(m) (vph)					997			
v/c					0.56			
95% queue length					3.57			
Control Delay					13.1			
LOS					B			
Approach Delay				13.1				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	54	31	249	59	0	0	0	0	31	86	12
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.86		0.77				0.80 0.80	
Flow Rate	98		399				91 67	
% Heavy Veh	17		4				1 1	
No. Lanes	1		1				2	
Opposing-Lanes	1		1				0	
Conflicting-lanes	2		2				1	
Geometry group	2		2				1	
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	98		399				91	67
Left-Turn	0		323				38	0
Right-Turn	36		0				0	14
Prop. Left-Turns	0.0		0.8				0.4	0.0
Prop. Right-Turns	0.4		0.0				0.0	0.2
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year:
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	40	46	0	0	265	23	42	63	88	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	99		373		82		136	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	99		373		82	136		
Left-Turn	46		0		47	0		
Right-Turn	0		29		0	100		
Prop. Left-Turns	0.5		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.3	0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	99		373		82	136		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.09		0.33		0.07	0.12		
hd, final value	5.15		4.59		5.17	4.62		
x, final value	0.14		0.48		0.12	0.17		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.2		2.6		3.2	2.6		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	99		373		82	136		
Service Time	3.2		2.6		3.2	2.6		
Utilization, x	0.14		0.48		0.12	0.17		
Dep. headway, hd	5.15		4.59		5.17	4.62		
Capacity	349		623		332	386		
Delay	9.00		11.69		8.87	8.59		
LOS	A		B		A	A		
Approach:								
Delay		9.00		11.69		8.69		
LOS		A		B		A		
Intersection Delay	10.36							

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	149	252	163	2	54	5	579	39	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	579	1653	0.76	0.35	26.4	C	23.9	C
R	560	1599	0.22	0.35	14.6	B		

Westbound

LTR	533	1524	0.12	0.35	13.7	B	13.7	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2286	4730	0.28	0.48	9.6	A	9.6	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 16.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	252	163	2	54	5	579	39	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	41	69	45	1	14	2	149	10	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		441	122		64			639				
%InSharedLn												
Prop LTs		0.372			0.031			0.934				
Prop RTs		0.000	1.000		0.078			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	252	163	2	54	5	579	39	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	164	277	122	2	57	5	597	40	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT		R	LTR			LTR					
Adj flow	441		122	64			639					
Prop LTs	0.372			0.031			0.934					
Prop RTs	0.000		1.000	0.078			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		0.952			0.990				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.989			1.000				
fLT	0.851			0.989			0.955				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1653	1599		1524			4730				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.76	0.35	17.3	1.000	579	0.50	9.1	0.0	26.4	C	23.9	C
R	0.22	0.35	13.7	1.000	560	0.50	0.9	0.0	14.6	B		
Westbound												
LTR	0.12	0.35	13.2	1.000	533	0.50	0.5	0.0	13.7	B	13.7	B
Northbound												
LTR	0.28	0.48	9.3	1.000	2286	0.50	0.3	0.0	9.6	A	9.6	A
Southbound												

Intersection delay = 16.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	164	2	
Proportion of LT in LT lane group, PLT	0.372	0.031	0.934
Proportion of LT in opposing flow, PLTo	0.03	0.37	
Adjusted opposing flow rate, Vo (veh/h)	64	441	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.07	7.35	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	9.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.97	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.03	
EL1 (refer to Exhibit C16-3)	1.47	2.17	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.85	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.851	0.989	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	9.31		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.443		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	64	441	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.372	0.031	0.934	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.078	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				60.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	17.3	0.00	0.0	0.0	26.4
R	0.0	0.00	19.5	13.7	0.00	0.0	0.0	14.6
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.3	0.00	0.0	0.0	9.6
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			16.1	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	441	122	64	234			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1653	1599	1524	1736			
LnCapacity	579	560	533	839			
Flow Ratio	0.3	0.1	0.0	0.1			
v/c Ratio	0.76	0.22	0.12	0.28			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.999	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	6.5	1.4	0.7	2.3			
kB	0.6	0.6	0.6	0.7			
Q2	1.7	0.2	0.1	0.3			
Q Average	8.2	1.6	0.8	2.6			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	10.0	2.0	1.0	3.3			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.6	1.7	1.6			
BOQ	12.0	2.6	1.3	4.1			
QSRatio							
90th Percentile Output:							
fB%	1.6	1.9	1.9	1.8			
BOQ	13.1	3.0	1.5	4.7			
QSRatio							
95th Percentile Output:							
fB%	1.8	2.3	2.5	2.2			
BOQ	14.7	3.7	2.0	5.7			
QSRatio							
98th Percentile Output:							
fB%	2.0	2.8	3.0	2.6			
BOQ	16.4	4.4	2.4	6.8			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	214		40				14	293		345	47	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 467 1752 0.67 0.27 26.9 C 26.9 C

Westbound

Northbound

LT 1091 1926 0.32 0.57 7.7 A 7.7 A

Southbound

TR 1167 2060 0.37 0.57 8.0 A 8.0 A

Intersection Delay = 13.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	214		40				14	293		345	47	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	66		12				4	84		95	13	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		313						353			431	
%InSharedLn												
Prop LTs		0.843						0.045			0.000	
Prop RTs		0.157						0.000			0.121	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	214		40				14	293		345	47	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	264		49				16	337		379	52	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		313						353			431	
Prop LTs		0.843						0.045			0.000	
Prop RTs		0.157						0.000			0.121	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.979						1.000			0.984		
fLT	0.960						0.977			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1752						1926			2060		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	313	1752	# 0.18	0.27	467	0.67
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	353	1926	0.18	0.57	1091	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	431	2060	# 0.21	0.57	1167	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.67	0.27	19.6	1.000	467	0.50	7.3	0.0	26.9	C	26.9	C
Westbound												
Northbound												
LT	0.32	0.57	6.9	1.000	1091	0.50	0.8	0.0	7.7	A	7.7	A
Southbound												
TR	0.37	0.57	7.1	1.000	1167	0.50	0.9	0.0	8.0	A	8.0	A

Intersection delay = 13.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		16	
Proportion of LT in LT lane group, PLT	0.843	0.045	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		431	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.27	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.18	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		4.14	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.62	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.15	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.977	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.14	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.122	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			431	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.045	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.121
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.6	0.00	0.0	0.0	26.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	6.9	0.00	0.0	0.0	7.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.1	0.00	0.0	0.0	8.0
	0.0						0.0	
Intersection Delay			13.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	313						353			431		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1752						1926			2060		
LnCapacity	467						1091			1167		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.67						0.32			0.37		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.7						3.1			3.9		
kB	0.5						0.9			0.9		
Q2	1.0						0.4			0.5		
Q Average	5.6						3.5			4.5		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.9						4.4			5.6		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	8.4						5.5			6.8		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.7			1.7		
BOQ	9.3						6.2			7.6		
QSRatio												
95th Percentile Output:												
fB%	1.9						2.1			2.0		
BOQ	10.8						7.4			9.0		
QSRatio												
98th Percentile Output:												
fB%	2.2						2.4			2.3		
BOQ	12.3						8.6			10.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	80		54				44	462		308	244	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	554	1663	0.28	0.33	16.0	B	16.0	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	841	1681	0.69	0.50	15.7	B	15.7	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	997	1993	0.59	0.50	13.1	B	13.1	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 14.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	80		54				44	462		308	244	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	23		16				13	133		85	67	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		156						582			591	
%InSharedLn												
Prop LTs		0.596						0.088			0.000	
Prop RTs	0.404						0.000			0.428		
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	80		54				44	462		308	244	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	93		63				51	531		338	253	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		156						582			591	
Prop LTs		0.596						0.088			0.000	
Prop RTs		0.404						0.000			0.428	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.945						1.000			0.942		
fLT	0.971						0.917			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1663						1681			1993		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	156	1663	# 0.09	0.33	554	0.28
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	582	1681	# 0.35	0.50	841	0.69
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	591	1993	0.30	0.50	997	0.59
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.44

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.53

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.28	0.33	14.7	1.000	554	0.50	1.3	0.0	16.0	B	16.0	B
Westbound												
Northbound												
LT	0.69	0.50	11.5	1.000	841	0.50	4.2	0.0	15.7	B	15.7	B
Southbound												
TR	0.59	0.50	10.7	1.000	997	0.50	2.5	0.0	13.1	B	13.1	B

Intersection delay = 14.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		51	
Proportion of LT in LT lane group, PLT	0.596	0.088	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		591	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.85	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.85	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		8.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		8.54	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		21.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.09	
EL1 (refer to Exhibit C16-3)		2.51	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.917	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			8.54	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.285	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		591	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.596		0.088	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.404	0.428
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.7	0.00	0.0	0.0	16.0
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.5	0.00	0.0	0.0	15.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	10.7	0.00	0.0	0.0	13.1
	0.0						0.0	
Intersection Delay			14.6	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	156						582			591		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1663						1681			1993		
LnCapacity	554						841			997		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.28						0.69			0.59		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.9						7.4			7.0		
kB	0.6						0.7			0.8		
Q2	0.2						1.5			1.2		
Q Average	2.1						8.9			8.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.7						10.8			10.0		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.4						12.9			11.9		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	3.9						14.1			13.0		
QSRatio												
95th Percentile Output:												
fB%	2.3						1.8			1.8		
BOQ	4.8						15.7			14.7		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.0			2.0		
BOQ	5.7						17.4			16.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	10		155	230	475	127	113	171		353		32
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.06	0.13	23.1	C	60.1	E
R	220	1652	0.91	0.13	62.5	E		
Westbound								
LTR	1339	4727	0.71	0.28	21.7	C	21.7	C
Northbound								
L	163	489	0.78	0.33	46.4	D	28.3	C
T	593	1778	0.32	0.33	16.3	B		
Southbound								
TR	690	2070	0.62	0.33	20.2	C	20.2	C

Intersection Delay = 26.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10		155	230	475	127	113	171		353	32	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		50	66	136	36	32	48		98	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	13		201		956		127	192			428	
%InSharedLn												
Prop LTs					0.276		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000		0.084		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10		155	230	475	127	113	171		353	32	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	13		201	264	546	146	127	192		392	36	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	13		201		956		127	192			428	
Prop LTs					0.276		1.000	0.000			0.000	
Prop RTs			1.000		0.153			0.000			0.084	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.943	0.943	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.977	0.977		1.000	0.989	0.989
fLT	0.950		0.986	0.986	0.273	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4727	4727	489	1778	2070	2070
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	1668	0.01	0.13	222	0.06
Prot							
Perm							
Thru							
Right	R	201	1652	# 0.12	0.13	220	0.91
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	956	4727	# 0.20	0.28	1339	0.71
Right							
Northbound							
Prot							
Perm							
Left	L	127	489	# 0.26	0.33	163	0.78
Prot							
Perm							
Thru	T	192	1778	0.11	0.33	593	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	428	2070	0.21	0.33	690	0.62
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.58

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.06	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	60.1	E	
R	0.91	0.13	25.7	1.000	220	0.50	36.9	0.0	62.5	E			
Westbound													
LTR	0.71	0.28	19.3	1.000	1339	0.50	2.4	0.0	21.7	C	21.7	C	
Northbound													
L	0.78	0.33	18.0	1.000	163	0.50	28.4	0.0	46.4	D	28.3	C	
T	0.32	0.33	14.9	1.000	593	0.50	1.4	0.0	16.3	B			
Southbound													
TR	0.62	0.33	16.8	1.000	690	0.50	3.4	0.0	20.2	C	20.2	C	

Intersection delay = 26.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			127	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			428	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.12	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.13	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			9.37	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			10.63	
n=Max(gq-gf)/2,0)			4.68	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.95	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.273	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.276 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.37	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.468	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			428	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.153	0.084
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	25.7	0.00	0.0	0.0	62.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.3	0.00	0.0	0.0	21.7
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	18.0	0.00	0.0	0.0	46.4
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.8	0.00	0.0	0.0	20.2
	0.0						0.0	
Intersection Delay			26.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	13	201		350		127	192		428
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1735		489	1778		2070
LnCapacity	222	220		491		163	593		690
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.2
v/c Ratio	0.06	0.91		0.71		0.78	0.32		0.62
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	3.3		5.2		1.9	2.4		6.0
kB	0.2	0.2		0.4		0.2	0.6		0.5
Q2	0.0	1.6		0.9		0.7	0.3		0.9
Q Average	0.2	4.9		6.1		2.6	2.7		6.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.3	6.0		7.5		3.3	3.3		8.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.5
BOQ	0.3	7.4		9.1		4.1	4.2		10.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.6
BOQ	0.4	8.2		10.1		4.7	4.8		11.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.0		1.9		2.2	2.2		1.9
BOQ	0.5	9.6		11.6		5.7	5.8		12.7
QSRatio									
98th Percentile Output:									
fB%	3.1	2.3		2.1		2.6	2.6		2.1
BOQ	0.6	11.1		13.1		6.7	6.9		14.3
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	15	8				6	278	116	234	475	28
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 454 1604 0.10 0.28 16.3 B 16.3 B

Westbound

Northbound

LTR 925 1682 0.49 0.55 10.0- A 10.0- A

Southbound

L 508 924 0.51 0.55 11.3 B
 TR 1018 1851 0.55 0.55 10.4 B 10.7 B

Intersection Delay = 10.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	15	8				6	278	116	234	475	28
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	78	33	65	132	8
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		45						449		260	559	
%InSharedLn												
Prop LTs		0.178						0.016		1.000	0.000	
Prop RTs		0.289						0.290			0.055	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	15	8				6	278	116	234	475	28
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	8	24	13				7	312	130	260	528	31
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	45						449			260	559	
Prop LTs	0.178						0.016			1.000	0.000	
Prop RTs	0.289						0.290			0.055		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW		1.033						1.133		1.000	1.000	
fHV		0.980						0.943		0.990	0.990	
fG		1.000						1.000		1.000	1.000	
fP		0.875						0.875		1.000	1.000	
fBB		1.000						0.992		1.000	0.992	
fA		1.000						1.000		1.000	1.000	
fLU		1.000						1.000		1.000	1.000	
fRT		0.961						0.961			0.992	
fLT		0.991						0.993		0.491	1.000	
Sec.												
fLpb		1.000						1.000		1.000	1.000	
fRpb		1.000						1.000			1.000	
S		1604						1682		924	1851	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	45	1604	# 0.03	0.28	454	0.10
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	449	1682	0.27	0.55	925	0.49
Right							
Southbound							
Prot							
Perm							
Left	L	260	924	0.28	0.55	508	0.51
Prot							
Perm							
Thru	TR	559	1851	# 0.30	0.55	1018	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.10	0.28	15.9	1.000	454	0.50	0.4	0.0	16.3	B	16.3	B
Westbound												
Northbound												
LTR	0.49	0.55	8.3	1.000	925	0.50	1.7	0.0	10.0-	A	10.0-	A
Southbound												
L	0.51	0.55	8.5	1.000	508	0.50	2.9	0.0	11.3	B		
TR	0.55	0.55	8.7	1.000	1018	0.50	1.7	0.0	10.4	B	10.7	B

Intersection delay = 10.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				260
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				449
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.33
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.48
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.82
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.18
n=Max(gq-gf)/2,0)				2.41
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.99
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.38
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				4.82
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.491

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		7	
Proportion of LT in LT lane group, PLT	0.178	0.016	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		559	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.12	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.32	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		22.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		6.60	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		10.68	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.44	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.993	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.60	4.82
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.200	0.146
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			559	449
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.016	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.289	0.290	0.055
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.5	0.00	0.0	0.0	11.3
TR	0.0	0.00	13.5	8.7	0.00	0.0	0.0	10.4
	0.0						0.0	

Intersection Delay	10.6	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR			L	TR
Init Queue		0.0						0.0			0.0	0.0
Flow Rate		45						449			260	559
So		1900						1900			1900	1900
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1604						1682			924	1851
LnCapacity		454						925			508	1018
Flow Ratio		0.0						0.3			0.3	0.3
v/c Ratio		0.10						0.49			0.51	0.55
Grn Ratio		0.28						0.55			0.55	0.55
I Factor		1.000						0.932				0.785
AT or PVG		3						3			3	3
Pltn Ratio		1.00						1.00			1.00	1.00
PF2		1.00						1.00			1.00	1.00
Q1		0.6						4.6			2.7	6.0
kB		0.5						0.8			0.4	0.7
Q2		0.1						0.7			0.4	0.8
Q Average		0.6						5.3			3.1	6.8
Q Spacing		25.0						25.0			25.0	25.0
Q Storage		0						0			0	0
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2			1.3	1.2
BOQ		0.8						6.5			3.9	8.4
QSRatio												
85th Percentile Output:												
fB%		1.7						1.5			1.6	1.5
BOQ		1.0						8.0			4.9	10.1
QSRatio												
90th Percentile Output:												
fB%		1.9						1.7			1.8	1.6
BOQ		1.2						8.9			5.6	11.1
QSRatio												
95th Percentile Output:												
fB%		2.5						1.9			2.1	1.9
BOQ		1.5						10.3			6.7	12.7
QSRatio												
98th Percentile Output:												
fB%		3.0						2.2			2.5	2.1
BOQ		1.8						11.8			7.9	14.2
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	5	8	17	265	26	105	21	290	170	90	373	19
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 628 1413 0.06 0.44 14.5 B 14.5 B

Westbound

L 547 1231 0.58 0.44 22.3 C
 T 763 1717 0.04 0.44 14.2 B 20.1 C
 R 563 1266 0.22 0.44 16.2 B

Northbound

LTR 695 1563 0.78 0.44 26.8 C 26.8 C

Southbound

LTR 620 1396 0.86 0.44 32.7 C 32.7 C

Intersection Delay = 26.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	8	17	265	26	105	21	290	170	90	373	19
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	3	5	79	8	31	6	81	48	25	104	5
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		38		315	31	125		541			535	
%InSharedLn												
Prop LTs		0.158		1.000	0.000			0.044			0.187	
Prop RTs		0.579			0.000	1.000		0.353			0.039	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.830			0.650			0.650	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	8	17	265	26	105	21	290	170	90	373	19
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	10	22	315	31	125	24	326	191	100	414	21
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	38			315 31 125			541			535		
Prop LTs	0.158			1.000 0.000			0.044			0.187		
Prop RTs	0.579			0.000 1.000			0.353			0.039		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.935	0.935	0.935	0.943		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.922		1.000 0.850			0.952		0.995		
fLT	0.980		0.732	1.000		0.966		0.756		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.996		
fRpb	0.968		1.000 1.000			0.980		1.000		
S	1413		1231	1717	1266	1563		1396		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	38	1413	0.03	0.44	628	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	315	1231	# 0.26	0.44	547	0.58
Prot							
Perm							
Thru	T	31	1717	0.02	0.44	763	0.04
Right	R	125	1266	0.10	0.44	563	0.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	541	1563	0.35	0.44	695	0.78
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	535	1396	# 0.38	0.44	620	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	628	0.50	0.2	0.0	14.5	B	14.5	B
Westbound												
L	0.58	0.44	18.7	1.000	547	0.50	3.6	0.0	22.3	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	20.1	C
R	0.22	0.44	15.4	1.000	563	0.50	0.8	0.0	16.2	B		
Northbound												
LTR	0.78	0.44	21.2	1.000	695	0.50	5.6	0.0	26.8	C	26.8	C
Southbound												
LTR	0.86	0.44	22.5	1.000	620	0.50	10.2	0.0	32.7	C	32.7	C

Intersection delay = 26.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		315		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		38		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.95		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.732		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	6	24	100
Proportion of LT in LT lane group, PLT	0.158	0.000	0.044
Proportion of LT in opposing flow, PLTo	0.00	0.19	0.04
Adjusted opposing flow rate, Vo (veh/h)	31	535	541
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.15	0.60	2.50
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	13.38	13.52
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	16.4	3.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.12	14.28
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	23.56	25.72
n=Max(gq-gf)/2,0)	0.00	0.00	5.31
PTHo=1-PLTo	1.00	0.81	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.19
EL1 (refer to Exhibit C16-3)	1.42	2.38	2.39
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.83
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.62
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.980	0.966	0.756

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.12	14.28
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.353	0.357
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	31	38	535	541
OCCr	0.000	0.053	0.000	0.022
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.978
Proportion of left turns, PLT	0.158	1.000	0.044	0.187
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.579	1.000	0.353	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.968	1.000	0.980	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.5
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.7	0.00	0.0	0.0	22.3
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.4	0.00	0.0	0.0	16.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.2	0.00	0.0	0.0	26.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	22.5	0.00	0.0	0.0	32.7
	0.0						0.0	
Intersection Delay			26.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	38			315	31	125	541			535		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1413			1231	1717	1266	1563			1396		
LnCapacity	628			547	763	563	695			620		
Flow Ratio	0.0			0.3	0.0	0.1	0.3			0.4		
v/c Ratio	0.06			0.58	0.04	0.22	0.78			0.86		
Grn Ratio	0.44			0.44	0.44	0.44	0.44			0.44		
I Factor	1.000			0.830			0.650			0.650		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.5			5.9	0.4	1.9	11.5			12.1		
kB	0.8			0.6	0.8	0.6	0.6			0.5		
Q2	0.1			0.8	0.0	0.2	1.8			2.7		
Q Average	0.6			6.7	0.5	2.1	13.3			14.7		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	0.8			8.2	0.6	2.7	16.1			17.7		
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.7	1.6	1.4			1.4		
BOQ	1.0			9.9	0.8	3.4	18.9			20.8		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.6	2.0	1.8	1.5			1.5		
BOQ	1.2			10.9	0.9	3.9	20.5			22.5		
QSRatio												
95th Percentile Output:												
fB%	2.5			1.9	2.5	2.3	1.7			1.7		
BOQ	1.5			12.5	1.2	4.8	22.3			24.3		
QSRatio												
98th Percentile Output:												
fB%	3.0			2.1	3.1	2.7	1.8			1.8		
BOQ	1.8			14.0	1.4	5.7	24.1			26.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 6/19/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	204		188	209	234		191		191			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				NB Thru			
	Right	P				NB Right	P		
	Peds					NB Peds			
WB	Left	P				SB Left			
	Thru	P				SB Thru			
	Right					SB Right			
	Peds					SB Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	923	1845	0.42	0.50	15.6	B	15.6	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	505	1009	0.96	0.50	53.6	D	53.6	D
----	-----	------	------	------	------	---	------	---

Northbound

LR	557	1433	0.78	0.39	33.7	C	33.7	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 35.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		204	188	209	234		191		191			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		57	52	57	64		54		54			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		387			487			434				
%InSharedLn												
Prop LTs		0.000			0.472			0.500				
Prop RTs		0.413			0.000			0.500				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		204	188	209	234		191		191			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		227	160	230	257		217		217			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		387			487			434				
Prop LTs		0.000			0.472			0.500				
Prop RTs		0.413			0.000			0.500				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.944			1.000			0.933					
fLT	1.000			0.544			0.976					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1845			1009			1433					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.42	0.50	14.2	1.000	923	0.50	1.3	0.0	15.6	B	15.6	B
Westbound												
LT	0.96	0.50	21.7	1.000	505	0.50	31.9	0.0	53.6	D	53.6	D
Northbound												
LR	0.78	0.39	24.1	1.000	557	0.50	9.6	0.0	33.7	C	33.7	C
Southbound												

Intersection delay = 35.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	230		
Proportion of LT in LT lane group, PLT	0.000	0.472	0.500
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	387		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.75		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	8.36		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	36.64		
n=Max(gq-gf)/2,0)	4.18		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.47		
EL1 (refer to Exhibit C16-3)	2.05		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.54		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.544		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.2	0.00	0.0	0.0	15.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	21.7	0.00	0.0	0.0	53.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	24.1	0.00	0.0	0.0	33.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			35.8	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		387			487			434				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1845			1009			1433				
LnCapacity		923			505			557				
Flow Ratio		0.2			0.5			0.3				
v/c Ratio		0.42			0.96			0.78				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		6.1			11.8			9.5				
kB		1.0			0.7			0.7				
Q2		0.7			5.5			2.2				
Q Average		6.9			17.3			11.7				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		8.4			20.8			14.1				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.4				
BOQ		10.1			24.3			16.7				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.5				
BOQ		11.2			26.2			18.1				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.6			1.7				
BOQ		12.7			28.2			19.8				
QSRatio												
98th Percentile Output:												
fB%		2.1			1.7			1.8				
BOQ		14.3			30.2			21.5				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	34	18	29	45	17	34	29	276	68	58	282	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left		P			NB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	15.0	7.0			23.0	0.0		
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 230 1968 0.41 0.12 30.0 C 30.0 C

Westbound

LTR 496 1984 0.24 0.25 19.1 B 19.1 B

Northbound

LTR 714 1863 0.60 0.38 18.5 B 18.5 B

Southbound

LTR 649 1692 0.70 0.38 21.8 C 21.8 C

Intersection Delay = 20.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	34	18	29	45	17	34	29	276	68	58	282	28
% Heavy Veh	2	2	2	1	1	1	6	6	6	9	9	9
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
PK 15 Vol	10	5	8	14	5	10	8	79	20	18	87	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		95			119			428			455	
%InSharedLn												
Prop LTs		0.421			0.471			0.077			0.158	
Prop RTs		0.358			0.353			0.182			0.077	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	34	18	29	45	17	34	29	276	68	58	282	28
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
Adj flow	40	21	34	56	21	42	33	317	78	72	348	35
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	95			119			428			455		
Prop LTs	0.421			0.471			0.077			0.158		
Prop RTs	0.358			0.353			0.182			0.077		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.980			0.990			0.943			0.917		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.952			0.952			0.975			0.990		
fLT	0.979			0.977			0.948			0.873		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1968			1984			1863			1692		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	95	1968	# 0.05	0.12	230	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	119	1984	# 0.06	0.25	496	0.24
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	428	1863	0.23	0.38	714	0.60
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	455	1692	# 0.27	0.38	649	0.70
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.38

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.41	0.12	24.6	1.000	230	0.50	5.4	0.0	30.0	C	30.0	C	
Westbound													
LTR	0.24	0.25	18.0	1.000	496	0.50	1.1	0.0	19.1	B	19.1	B	
Northbound													
LTR	0.60	0.38	14.8	1.000	714	0.50	3.7	0.0	18.5	B	18.5	B	
Southbound													
LTR	0.70	0.38	15.6	1.000	649	0.50	6.2	0.0	21.8	C	21.8	C	

Intersection delay = 20.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	72
Proportion of LT in LT lane group, PLT	0.421	0.471	0.077	0.158
Proportion of LT in opposing flow, PLTo			0.16	0.08
Adjusted opposing flow rate, Vo (veh/h)			455	428
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	1.20
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.58	7.13
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	3.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			8.86	8.23
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.14	14.77
n=Max(gq-gf)/2,0)			0.56	2.23
PTHo=1-PLTo			0.84	0.92
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.08	0.16
EL1 (refer to Exhibit C16-3)			2.20	2.14
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	2.12
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			1.11	4.46
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.95	0.87
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.948	0.873

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.23
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.358
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				428
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.158
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.358	0.182
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	30.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.0	0.00	0.0	0.0	19.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.8	0.00	0.0	0.0	18.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	15.6	0.00	0.0	0.0	21.8
	0.0						0.0	
Intersection Delay			20.9	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	95		119		428		455	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	0 1 0	0 0	0 1 0	0 0	0 1 0	0 0
SL	1968		1984		1863		1692	
LnCapacity	230		496		714		649	
Flow Ratio	0.0		0.1		0.2		0.3	
v/c Ratio	0.41		0.24		0.60		0.70	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.5		1.6		5.7		6.4	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.2		1.0		1.4	
Q Average	1.7		1.7		6.7		7.8	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.1		2.2		8.2		9.5	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.7		2.8		9.9		11.4	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.9		1.6		1.6	
BOQ	3.1		3.2		10.9		12.5	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.3		1.9		1.8	
BOQ	3.9		4.0		12.5		14.1	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.8		2.1		2.0	
BOQ	4.7		4.8		14.0		15.7	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			344	63		19	337	
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81	
Hourly Flow Rate, HFR			395	72		23	416	
Percent Heavy Vehicles			--	--		7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		111		31				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		163		45				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10
Lane Config		LT			LR			
v (vph)		23			208			
C(m) (vph)		1069			336			
v/c		0.02			0.62			
95% queue length		0.07			3.92			
Control Delay		8.4			31.6			
LOS		A			D			
Approach Delay					31.6			
Approach LOS					D			

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		344	63	19	337	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		99	18	6	104	
Hourly Flow Rate, HFR		395	72	23	416	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	111		31			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	41		11			
Hourly Flow Rate, HFR	163		45			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		416
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		467	893		431			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	431	
Potential Capacity	614	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	614	
Probability of Queue free St.	0.93	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	467	
Potential Capacity	1069	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1069	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.97	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	893	
Potential Capacity	306	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.91
Movement Capacity	299	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 893
Potential Capacity 306
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.97
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.91
Movement Capacity 299

Results for Two-stage process:

a
y
C t 299

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	163		45			
Movement Capacity (vph)	299		614			
Shared Lane Capacity (vph)		336				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	299		614			
Volume	163		45			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		336				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		23		208				
C(m) (vph)		1069		336				
v/c		0.02		0.62				
95% queue length		0.07		3.92				
Control Delay		8.4		31.6				
LOS		A		D				
Approach Delay				31.6				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		416
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.97
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	11	2	377	20	306	4	183	341	295	261	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	725	1740	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	528	1268	0.92	0.42	38.6	D	31.4	C
R	523	1256	0.71	0.42	22.1	C		

Northbound

LTR	745	1788	0.76	0.42	21.7	C	21.7	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	381	915	1.70	0.42	342.8	F	342.8	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 125.1 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	377	20	306	4	183	341	295	261	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	115	6	93	1	49	92	86	76	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			484	373		568			647	
%InSharedLn												
Prop LTs		0.063			0.950			0.007			0.530	
Prop RTs		0.125			0.000	1.000		0.646			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	377	20	306	4	183	341	295	261	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	460	24	373	4	197	367	343	303	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			484 373			568			647		
Prop LTs	0.063			0.950			0.007			0.530		
Prop RTs	0.125			0.000 1.000			0.646			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.983			1.000 0.850			0.913			1.000		
fLT	0.982			0.725			0.996			0.458		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1740			1268 1256			1788			915		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1740	0.01	0.42	725	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1268	# 0.38	0.42	528	0.92
Right	R	373	1256	0.30	0.42	523	0.71
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	568	1788	0.32	0.42	745	0.76
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	647	915	# 0.71	0.42	381	1.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.09
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.31

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	725	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.92	0.42	16.5	1.000	528	0.50	22.0	0.0	38.6	D	31.4	C
R	0.71	0.42	14.5	1.000	523	0.50	7.5	0.0	22.1	C		
Northbound												
LTR	0.76	0.42	15.0	1.000	745	0.50	6.7	0.0	21.7	C	21.7	C
Southbound												
LTR	1.70	0.42	17.5	1.000	381	0.50	325.3	0.0	342.8	F	342.8	F

Intersection delay = 125.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	460	4	343
Proportion of LT in LT lane group, PLT	0.063	0.950	0.007	0.530
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.53	0.01
Adjusted opposing flow rate, Vo (veh/h)	484	16	647	568
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.67	0.07	5.72
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.07	0.27	10.78	9.47
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.69	0.00	12.08	10.47
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	14.53
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	5.24
PTHo=1-PLTo	0.05	0.94	0.47	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.01	0.53
EL1 (refer to Exhibit C16-3)	2.26	1.40	2.66	2.46
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	5.16
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	10.47
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.46
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.725	0.996	0.458

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.69		12.08	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.348		0.483	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	484		647	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.5	0.00	0.0	0.0	38.6
R	0.0	0.00	17.5	14.5	0.00	0.0	0.0	22.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.0	0.00	0.0	0.0	21.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	66.5	0.0	342.8
	0.0						0.0	
Intersection Delay			125.1	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	16			484	373	568		647	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1740			1268	1256	1788		915	
LnCapacity	725			528	523	745		381	
Flow Ratio	0.0			0.4	0.3	0.3		0.7	
v/c Ratio	0.02			0.92	0.71	0.76		1.70	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.933		0.919		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.2			7.6	5.2	8.1		10.8	
kB	0.7			0.5	0.5	0.6		0.4	
Q2	0.0			3.5	1.2	1.9		34.3	
Q Average	0.2			11.1	6.4	10.0		45.1	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.2			13.4	7.8	12.1		54.1	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.4	1.5	1.4		1.4	
BOQ	0.3			15.9	9.4	14.4		63.1	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.6	1.6	1.6		1.5	
BOQ	0.3			17.2	10.4	15.7		67.6	
QSRatio									
95th Percentile Output:									
fB%	2.6			1.7	1.9	1.7		1.6	
BOQ	0.4			18.9	11.9	17.3		72.1	
QSRatio									
98th Percentile Output:									
fB%	3.1			1.9	2.1	1.9		1.7	
BOQ	0.5			20.6	13.5	19.0		76.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				462		4		524			640	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas
 Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.83 0.33 23.0 C 23.0 C

Northbound

T 1026 2051 0.55 0.50 12.3 B 12.3 B

Southbound

T 954 1907 0.78 0.50 14.5 B 14.5 B

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				462		4	524			640		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				138		1	141			186		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					555		563			744		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0						30.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				462		4	524			640		
PHF				0.84		0.84	0.93			0.86		
Adj flow				550		5	563			744		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					555			563			744	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
fLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	555	2009	# 0.28	0.33	670	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	563	2051	0.27	0.50	1026	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	744	1907	# 0.39	0.50	954	0.78
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.83	0.33	18.4	1.000	670	0.50	4.6	0.0	23.0	C	23.0	C
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Northbound

T	0.55	0.50	10.3	1.000	1026	0.50	1.9	0.0	12.3	B	12.3	B
---	------	------	------	-------	------	------	-----	-----	------	---	------	---

Southbound

T	0.78	0.50	12.3	1.000	954	0.50	2.2	0.0	14.5	B	14.5	B
---	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

60.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.4	0.00	0.0	0.0	23.0
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.3	0.00	0.0	0.0	12.3
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	12.3	0.00	0.0	0.0	14.5
	0.0						0.0	
Intersection Delay			16.4	sec/veh	Intersection LOS			B

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		524	262			188	914	
Peak-Hour Factor, PHF		0.93	0.93			0.86	0.86	
Hourly Flow Rate, HFR		563	281			218	1062	
Percent Heavy Vehicles		--	--			18	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		218						
C(m) (vph)		728						
v/c		0.30						
95% queue length		1.26						
Control Delay		12.0						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		524	262	188	914	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		141	70	55	266	
Hourly Flow Rate, HFR		563	281	218	1062	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		1062
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		844						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)
s
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	844	
Potential Capacity	728	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	728	
Probability of Queue free St.	0.70	1.00
Maj L-Shared Prob Q free St.	0.20	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.20	0.20
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.70	0.70
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.20 0.20
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.70 0.70
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		218						
C(m) (vph)		728						
v/c		0.30						
95% queue length		1.26						
Control Delay		12.0						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.70
v(i1), Volume for stream 2 or 5		1062
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.20
d(M,LT), Delay for stream 1 or 4		12.0
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		9.6

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				134		181	592	105		150	749	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 397 1487 0.94 0.27 52.6 D 52.6 D

Northbound

TR 1098 1937 0.68 0.57 12.0 B 12.0 B

Southbound

LT 661 1167 1.58 0.57 275.3 F 275.3 F

Intersection Delay = 145.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				134		181	592	105		150	749	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				40		54	159	28		44	218	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					375			750			1045	
%InSharedLn												
Prop LTs					0.427			0.000			0.167	
Prop RTs					0.573			0.151			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				134		181	592	105		150	749	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				160		215	637	113		174	871	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					375			750			1045	
Prop LTs					0.427			0.000			0.167	
Prop RTs					0.573			0.151			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.923			0.980			1.000	
fLT					0.979			1.000			0.597	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1487			1937			1167	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	375	1487	# 0.25	0.27	397	0.94
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	750	1937	0.39	0.57	1098	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1045	1167	# 0.90	0.57	661	1.58
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.15
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.38

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.94	0.27	21.6	1.000	397	0.50	31.0	0.0	52.6	D	52.6	D
Northbound												
TR	0.68	0.57	9.2	1.000	1098	0.50	2.8	0.0	12.0	B	12.0	B
Southbound												
LT	1.58	0.57	13.0	1.000	661	0.50	262.3	0.0	275.3	F	275.3	F

Intersection delay = 145.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			174
Proportion of LT in LT lane group, PLT	0.427	0.000	0.167
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			750
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.90
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.95
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.05
n=Max(gq-gf)/2,0)			3.81
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.17
EL1 (refer to Exhibit C16-3)			2.94
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.60
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.597

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.95
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.263
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				750
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.167
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.573	0.151
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.6	0.00	0.0	0.0	52.6
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.2	0.00	0.0	0.0	12.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	96.0	0.0	275.3
	0.0						0.0	
Intersection Delay			145.8	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	96	49	133	35	195	82	90	590	109	151	561	53
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 440 1278 0.72 0.34 30.7 C 30.7 C

Westbound

LTR 563 1634 0.68 0.34 31.9 C 31.9 C

Northbound

L 256 470 0.39 0.54 15.2 B
 TR 1067 1959 0.71 0.54 18.4 B 18.1 B

Southbound

LTR 917 1684 0.95 0.54 38.0 D 38.0 D

Intersection Delay = 29.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	96	49	133	35	195	82	90	590	109	151	561	53
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.92	0.91	0.87	0.87	0.87
PK 15 Vol	27	14	38	11	60	25	25	160	30	43	161	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		316			385		99	761			868	
%InSharedLn												
Prop LTS		0.345			0.112		1.000	0.000			0.200	
Prop RTS		0.478			0.262			0.158			0.056	
Peds Bikes	0	0		0	0		0	0	0	0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	96	49	133	35	195	82	90	590	109	151	561	53
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.92	0.91	0.87	0.87	0.87
Adj flow	109	56	151	43	241	101	99	641	120	174	645	49
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	316			385			99 761			868		
Prop LTs	0.345			0.112			1.000 0.000			0.200		
Prop RTs	0.478			0.262			0.158			0.056		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.935			0.965			0.976			0.992		
fLT	0.641			0.936			0.268 1.000			0.538		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1278			1634			470 1959			1684		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	316	1278	# 0.25	0.34	440	0.72
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	385	1634	0.24	0.34	563	0.68
Right							
Northbound							
Prot							
Perm							
Left	L	99	470	0.21	0.54	256	0.39
Prot							
Perm							
Thru	TR	761	1959	0.39	0.54	1067	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	868	1684	# 0.52	0.54	917	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.72	0.34	25.7	1.000	440	0.50	5.0	0.0	30.7	C	30.7	C
Westbound												
LTR	0.68	0.34	25.3	1.000	563	0.50	6.6	0.0	31.9	C	31.9	C
Northbound												
L	0.39	0.54	11.8	1.000	256	0.50	3.4	0.0	15.2	B		
TR	0.71	0.54	15.3	1.000	1067	0.50	3.2	0.0	18.4	B	18.1	B
Southbound												
LTR	0.95	0.54	19.3	1.000	917	0.50	18.7	0.0	38.0	D	38.0	D

Intersection delay = 29.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			99	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.20	
Adjusted opposing flow rate, Vo (veh/h)			868	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.48	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			8.91	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.09	
n=Max(gq-gf)/2,0)			4.45	
PTHo=1-PLTo			0.80	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.06	
EL2=Max((1-Ptho**n)/Plto, 1.0)			3.15	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			8.91	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.268	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	109	43	174
Proportion of LT in LT lane group, PLT	0.345	0.112	0.000
Proportion of LT in opposing flow, PLTo	0.11	0.34	0.00
Adjusted opposing flow rate, Vo (veh/h)	385	316	761
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	1.08	4.35
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.63	7.90	19.02
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.2	7.6	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	12.73	10.25	25.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.27	20.75	23.97
n=Max(gq-gf)/2,0)	5.79	1.33	12.51
PTHo=1-PLTo	0.89	0.66	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.34	0.11	1.00-
EL1 (refer to Exhibit C16-3)	2.05	1.91	2.97
EL2=Max((1-Ptho**n)/Plto, 1.0)	4.44	1.24	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.08
gdifff=max(gq-gf,0)	11.57	2.65	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.94	0.17
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.641	0.936	0.538

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	12.73	10.25	8.91	25.03
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.411	0.331	0.182	0.511
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	385	316	868	761
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.345	0.112	1.000	0.200
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.478	0.262	0.158	0.056
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial		Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
	Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	25.7	0.00	0.0	0.0 0.0 0.0	30.7
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	25.3	0.00	0.0	0.0 0.0 0.0	31.9
Northbound								
L	0.0	0.00	20.5	11.8	0.00	0.0	0.0	15.2
TR	0.0 0.0	0.00	20.5	15.3	0.00	0.0	0.0 0.0	18.4
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	19.3	0.00	0.0	0.0 0.0 0.0	38.0

Intersection Delay	29.0	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	316		385		99	761	455	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0		0 1 0		1 1 0		0 2 0	
SL	1278		1634		470	1959	884	
LnCapacity	440		563		256	1067	481	
Flow Ratio	0.2		0.2		0.2	0.4	0.5	
v/c Ratio	0.72		0.68		0.39	0.71	0.95	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	6.9		8.3		1.4	14.2	10.7	
kB	0.3		0.8		0.3	0.9	0.7	
Q2	0.8		1.5		0.2	2.2	4.7	
Q Average	7.7		9.8		1.6	16.3	15.4	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	9.4		11.9		2.1	19.7	18.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.6	1.4	1.4	
BOQ	11.2		14.1		2.7	23.1	21.7	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.5	
BOQ	12.3		15.4		3.1	24.8	23.4	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.7		2.3	1.6	1.6	
BOQ	13.9		17.1		3.8	26.8	25.3	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.9		2.8	1.8	1.8	
BOQ	15.5		18.7		4.6	28.7	27.2	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	379						769			694		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0					50.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	675	2025	0.62	0.33	29.4	C	29.4	C

Westbound

Northbound

T 2156 3880 0.40 0.56 11.8 B 11.8 B

Southbound

T 1990 3582 0.40 0.56 12.0 B 12.0 B

Intersection Delay = 15.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	379						769			694		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	104						214			199		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	416						854			798		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	379						769			694		
PHF	0.91						0.90			0.87		
Adj flow	416						854			798		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	416						854			798		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2025						3880			3582		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	416	2025	# 0.21	0.33	675	0.62
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	854	3880	0.22	0.56	2156	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	798	3582	# 0.22	0.56	1990	0.40
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.43$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.48$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.62	0.33	25.2	1.000	675	0.50	4.2	0.0	29.4	C	29.4	C	
Westbound													
Northbound													
T	0.40	0.56	11.4	1.000	2156	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.40	0.56	11.4	1.000	1990	0.50	0.6	0.0	12.0	B	12.0	B	

Intersection delay = 15.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	416						448		419	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.62						0.40		0.40	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.7						6.4		6.0	
kB	0.9						1.0		1.1	
Q2	1.3						0.6		0.7	
Q Average	10.1						7.0		6.7	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	12.2						8.6		8.3	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	14.5						10.3		10.0	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.6	
BOQ	15.8						11.4		11.0	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	17.4						12.9		12.5	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.1	
BOQ	19.1						14.5		14.1	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					694	
Peak-Hour Factor, PHF					0.87	
Peak-15 Minute Volume					199	
Hourly Flow Rate, HFR					797	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						71
Peak Hour Factor, PHF						0.78
Peak-15 Minute Volume						23
Hourly Flow Rate, HFR						91
Percent Heavy Vehicles						55
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x								398
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		398
Potential Capacity		551
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		551
Probability of Queue free St.	1.00	0.83

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	401
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	401
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	401	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	401	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	447
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	447

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	683	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity	570	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						91
Movement Capacity (vph)						551
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						551
Volume						91
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								91
C(m) (vph)								551
v/c								0.17
95% queue length								0.59
Control Delay								12.8
LOS								B
Approach Delay							12.8	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 With-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	161	344	210	247	532	87	159	285	150	223	77	106
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	140	420	1.31	0.33	199.5	F		
TR	597	1790	0.97	0.33	53.9	D	88.9	F
Westbound								
L	240	696	1.14	0.34	129.7	F		
TR	1143	3317	0.65	0.34	27.6	C	55.2	E
Northbound								
LTR	946	3406	0.65	0.28	32.0	C	32.0	C
Southbound								
L	384	1728	0.76	0.22	45.8	D		
TR	360	1620	0.58	0.22	37.7	D	42.4	D

Intersection Delay = 56.9 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161	344	210	247	532	87	159	285	150	223	77	106
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	46	98	60	69	162	27	43	77	40	73	25	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	183	579		274	742			611		293	208	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.280			0.000	
Prop RTs		0.325			0.125			0.219			0.514	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161	344	210	247	532	87	159	285	150	223	77	106
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	183	391	188	274	649	93	171	306	134	293	101	107
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	183	579		274	742		611			293	208	
Prop LTs	1.000	0.000		1.000	0.000		0.280			0.000		
Prop RTs		0.325			0.125		0.219				0.514	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.951			0.981		0.967				0.923	
fLT	0.231	1.000		0.409*	1.000		0.986			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	420	1790		696	3317		3406			1728	1620	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	183	420	# 0.44	0.33	140	1.31
Prot							
Perm							
Thru	TR	579	1790	0.32	0.33	597	0.97
Right							
Westbound							
Prot							
Perm							
Left	L	274	696	0.39	0.34	240	1.14
Prot							
Perm							
Thru	TR	742	3317	0.22	0.34	1143	0.65
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	611	3406	# 0.18	0.28	946	0.65
Right							
Southbound							
Prot							
Perm							
Left	L	293	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	208	1620	0.13	0.22	360	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.31	0.33	30.0	1.000	140	0.50	169.5	0.0	199.5	F			
TR	0.97	0.33	29.6	1.000	597	0.50	24.3	0.0	53.9	D	88.9	F	
Westbound													
L	1.14	0.34	29.5	1.000	240	0.50	100.2	0.0	129.7	F			
TR	0.65	0.34	24.9	1.000	1143	0.50	2.7	0.0	27.6	C	55.2	E	
Northbound													
LTR	0.65	0.28	28.6	1.000	946	0.50	3.4	0.0	32.0	C	32.0	C	
Southbound													
L	0.76	0.22	32.8	1.000	384	0.50	13.0	0.0	45.8	D			
TR	0.58	0.22	31.2	1.000	360	0.50	6.4	0.0	37.7	D	42.4	D	

Intersection delay = 56.9 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	183	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	742	579		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.58	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.74	14.48		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	11.30	24.45		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.70	6.55		
n=Max(gq-gf)/2,0)	5.65	12.23		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.70	2.24		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.231	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.280 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	11.30			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.377			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	742			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	10.8	0.0	199.5
TR	0.0	0.00	30.0	29.6	0.00	0.0	0.0	53.9
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	8.5	0.0	129.7
TR	0.0	0.00	29.5	24.9	0.00	0.0	0.0	27.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.6	0.00	0.0	0.0	32.0
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.8
TR	0.0	0.00	35.0	31.2	0.00	0.0	0.0	37.7
	0.0						0.0	

Intersection Delay	56.9	sec/veh	Intersection LOS	E
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	183	579		274	389		320			293	208	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	420	1790		696	1742		1788			1728	1620	
LnCapacity	140	597		240	600		496			384	360	
Flow Ratio	0.4	0.3		0.4	0.2		0.2			0.2	0.1	
v/c Ratio	1.31	0.97		1.14	0.65		0.65			0.76	0.58	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.6	14.3		6.8	8.2		7.0			6.9	4.6	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	6.1	5.3		6.4	1.3		1.2			1.6	0.7	
Q Average	10.7	19.6		13.2	9.5		8.2			8.5	5.4	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	13.0	23.5		16.0	11.6		10.1			10.3	6.6	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.5			1.5	1.5	
BOQ	15.4	27.5		18.8	13.8		12.0			12.3	8.0	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.5	1.6		1.6			1.6	1.7	
BOQ	16.7	29.6		20.3	15.0		13.2			13.5	8.9	
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.7	1.7		1.8			1.8	1.9	
BOQ	18.4	31.7		22.1	16.7		14.8			15.1	10.4	
QSRatio												
98th Percentile Output:												
fB%	1.9	1.7		1.8	1.9		2.0			2.0	2.2	
BOQ	20.1	33.9		23.9	18.3		16.4			16.7	11.9	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						534			
Peak-Hour Factor, PHF						0.93			
Hourly Flow Rate, HFR						574			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		407							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		437							
Percent Heavy Vehicles		3							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage				/				/	
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			437							
C(m) (vph)			479							
v/c			0.91							
95% queue length			10.44							
Control Delay			51.7							
LOS			F							
Approach Delay				51.7						
Approach LOS				F						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 534
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 144
 Hourly Flow Rate, HFR 574
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 407
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 109
 Hourly Flow Rate, HFR 437
 Percent Heavy Vehicles 3
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			574					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	574	
Potential Capacity	479	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	479	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 574
Potential Capacity 479
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 479

Results for Two-stage process:
a
y
C t 479

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	437					
Movement Capacity (vph)	479					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	479					
Volume	437					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			437					
C(m) (vph)			479					
v/c			0.91					
95% queue length			10.44					
Control Delay			51.7					
LOS			F					
Approach Delay				51.7				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

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-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	14	161	55	147	206	165	16	39	69	80	193	60
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.87	0.87	0.91	0.91	0.76	0.76	1.00	1.00
Flow Rate	107	156	274	294	72	90	176	157
% Heavy Veh	7	7	1	1	1	1	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	107	156	274	294	72	90	176	157
Left-Turn	16	0	161	0	21	0	80	0
Right-Turn	0	63	0	181	0	90	0	60
Prop. Left-Turns	0.1	0.0	0.6	0.0	0.3	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.4	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.2	-0.2	0.3	-0.4	0.2	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	107	156	274	294	72	90	176	157
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.10	0.14	0.24	0.26	0.06	0.08	0.16	0.14
hd, final value	7.05	6.69	6.75	6.03	7.44	6.59	7.18	6.69
x, final value	0.21	0.29	0.51	0.49	0.15	0.16	0.35	0.29
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	4.8	4.4	4.5	3.7	5.1	4.3	4.9	4.4

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	107	156	274	294	72	90	176	157
Service Time	4.8	4.4	4.5	3.7	5.1	4.3	4.9	4.4
Utilization, x	0.21	0.29	0.51	0.49	0.15	0.16	0.35	0.29
Dep. headway, hd	7.05	6.69	6.75	6.03	7.44	6.59	7.18	6.69
Capacity	357	406	522	544	322	340	426	407
Delay	11.61	12.10	16.38	14.43	11.43	10.59	13.72	12.12
LOS	B	B	C	B	B	B	B	B
Approach:								
Delay	11.90		15.37		10.96		12.97	
LOS	B		C		B		B	
Intersection Delay	13.54		Intersection LOS		B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	53	137	504	239	463	10	286	145	124	21	532	123
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0				29.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	804	3148	0.98	0.26	58.9	E	58.9	E
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	890	3481	0.98	0.26	56.9	E	56.9	E
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	146	452	2.11	0.32	552.2	F		
TR	583	1810	0.50	0.32	27.6	C	298.3	F

Southbound

LTR	956	2968	0.75	0.32	32.7	C	32.7	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 100.1 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	53	137	504	239	463	10	286	145	124	21	532	123
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	15	39	143	73	141	3	77	39	33	6	141	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		789			868		308	289			719	
%InSharedLn												
Prop LTs		0.076			0.335		1.000	0.000			0.031	
Prop RTs		0.726			0.014			0.460			0.182	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	53	137	504	239	463	10	286	145	124	21	532	123
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	60	156	573	291	565	12	308	156	133	22	566	131
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	789			868			308 289			719		
Prop LTs	0.076			0.335			1.000 0.000			0.031		
Prop RTs	0.726			0.014			0.460			0.182		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.891			0.998			0.931			0.973		
fLT	0.996			0.984			0.233 1.000			0.939		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3148			3481			452 1810			2968		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	789	3148	# 0.25	0.26	804	0.98
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	868	3481	# 0.25	0.26	890	0.98
Right							
Northbound							
Prot							
Perm							
Left	DefL	308	452	# 0.68	0.32	146	2.11
Prot							
Perm							
Thru	TR	289	1810	0.16	0.32	583	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	719	2968	0.24	0.32	956	0.75
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.18
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.42

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.98	0.26	33.3	1.000	804	0.50	25.7	0.0	58.9	E	58.9	E	
Westbound													
LTR	0.98	0.26	33.2	1.000	890	0.50	23.7	0.0	56.9	E	56.9	E	
Northbound													
DefL	2.11	0.32	30.5	1.000	146	0.50	521.7	0.0	552.2	F			
TR	0.50	0.32	24.6	1.000	583	0.50	3.0	0.0	27.6	C	298.3	F	
Southbound													
LTR	0.75	0.32	27.3	1.000	956	0.50	5.4	0.0	32.7	C	32.7	C	

Intersection delay = 100.1 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			308	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			719	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.70	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.44	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			11.19	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			17.81	
n=Max(gq-gf)/2,0)			5.60	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.64	
EL2=Max((1-Ptho*n)/Plto, 1.0)			5.22	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			11.19	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.23	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.233	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	22
Proportion of LT in LT lane group, PLT	0.076 0.335 0.000 0.031
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	289
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.55
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.61
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	11.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.32
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.67
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07
EL1 (refer to Exhibit C16-3)	1.86
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdif=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.939

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.32
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.011
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				289
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.031
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.726	0.014	0.460
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	33.3	0.00	0.0	0.0 0.0 0.0	58.9
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	33.2	0.00	0.0	0.0 0.0 0.0	56.9
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	40.5	0.0	552.2
TR	0.0 0.0	0.00	30.5	24.6	0.00	0.0	0.0 0.0	27.6
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	27.3	0.00	0.0	0.0 0.0 0.0	32.7
Intersection Delay			100.1	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	414		455		308	289	377	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1653		1828		452	1810	1558	
LnCapacity	422		467		146	583	502	
Flow Ratio	0.3		0.2		0.7	0.2	0.2	
v/c Ratio	0.98		0.97		2.11	0.50	0.75	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	10.3		11.3		7.7	5.8	8.4	
kB	0.6		0.6		0.3	0.8	0.7	
Q2	4.9		5.2		20.8	0.8	1.9	
Q Average	15.2		16.5		28.5	6.6	10.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	18.3		19.9		34.2	8.1	12.5	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.4	
BOQ	21.4		23.3		39.9	9.7	14.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.6	
BOQ	23.1		25.1		42.8	10.8	16.1	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.6		1.6	1.9	1.7	
BOQ	25.0		27.0		45.7	12.3	17.8	
QSRatio								
98th Percentile Output:								
fB%	1.8		1.8		1.7	2.1	1.9	
BOQ	26.9		29.0		48.6	13.8	19.5	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	747	395	4	3	404	868	2	3	2	151	0	288
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	788	1728	1.05	0.73	60.9	E		
TR	1206	1644	0.37	0.73	5.0	A	41.4	D
Westbound								
LT	584	1876	0.70	0.31	31.9	C	295.3	F
R	497	1599	1.84	0.31	413.7	F		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.79	0.16	62.5	E		
LT	283	1818	0.00	0.16	32.1	C	27.7	C
R	862	1492	0.42	0.58	12.1	B		

Intersection Delay = 146.4 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	747	395	4	3	404	868	2	3	2	151	0	288
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.99	0.95	0.44	0.44	0.44	0.94	0.80	0.80
PK 15 Vol	208	110	1	1	102	228	1	2	1	40	0	90
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	830	443			411	914		17		161	0	360
%InSharedLn										0		
Prop LTs	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTs		0.009			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.687			0.650			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		33.0	28.0				14.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	747	395	4	3	404	868	2	3	2	151	0	288
PHF	0.90	0.90	0.90	0.95	0.99	0.95	0.44	0.44	0.44	0.94	0.80	0.80
Adj flow	830	439	4	3	408	914	5	7	5	161	0	360
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	830	443			411	914		17		161	0	360
Prop LTs	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTs		0.009			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.231											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1644		1876	1599		952			1310	1818	1492
Sec.	421											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		634	1728	# 0.37	0.367	634	1.00
Perm		196	421	0.47	0.367	154	1.27
Left	L	830			0.73	788	1.05
Prot							
Perm							
Thru	TR	443	1644	0.27	0.73	1206	0.37
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	411	1876	0.22	0.31	584	0.70
Right	R	914	1599	# 0.57	0.31	497	1.84
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	161	1310	# 0.12	0.16	204	0.79
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	360	1492	0.24	0.58	862	0.42

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.06
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.27

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.05	0.73	19.1	1.000	788	0.50	41.8	0.0	60.9	E			
TR	0.37	0.73	4.4	1.000	1206	0.50	0.6	0.0	5.0	A	41.4	D	
Westbound													
LT	0.70	0.31	27.3	1.000	584	0.50	4.6	0.0	31.9	C	295.3	F	
R	1.84	0.31	31.0	1.000	497	0.50	382.7	0.0	413.7	F			
Northbound													
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C	
Southbound													
L	0.79	0.16	36.6	1.000	204	0.50	25.9	0.0	62.5	E			
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	27.7	C	

R 0.42 0.58 10.6 1.000 862 0.50 1.5 0.0 12.1 B

Intersection delay = 146.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	830			161
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	411			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.75			4.03
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.27			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	18.35			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.65			14.00
n=Max(gq-gf)/2,0)	9.17			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.92			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	8.90			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	18.35			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.231			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.007	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	443	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.07	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.17	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		443		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.007		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	66.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	66.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.009
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

-----SUPPLEMENTAL UNIFORM DELAY WORKSHEET-----

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	830			
v/c ratio from Capacity Worksheet, X	1.05			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	18.35			
Unopposed green interval, gu	14.65			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.26			
XPerm	1.87			
XProt	0.79			
Case	3			
Queue at beginning of green arrow, Qa	8.62			
Queue at beginning of unsaturated green, Qu	4.02			
Residual queue, Qr	3.36			
Uniform Delay, d1	19.1			

-----DELAY/LOS WORKSHEET WITH INITIAL QUEUE-----

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		19.1	0.00	10.5	0.0	60.9
TR	0.0	0.00	12.0	4.4	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	27.3	0.00	0.0	0.0	31.9
R	0.0	0.00	31.0	31.0	0.00	104.3	0.0	413.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	36.6	0.00	0.0	0.0	62.5
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.6	0.00	0.0	0.0	12.1

Intersection Delay	146.4	sec/veh	Intersection LOS	F
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-----BACK OF QUEUE WORKSHEET-----

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	830	443		411	914		17	161	0	360
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1074	1644		1876	1599		952	1310	1818	1492
LnCapacity	788	1206		584	497		148	204	283	862
Flow Ratio	0.8	0.3		0.2	0.6		0.0	0.1	0.0	0.2
v/c Ratio	1.05	0.37		0.70	1.84		0.11	0.79	0.00	0.42
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.7	4.0		9.1	22.9		0.4	3.9	0.0	5.0
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	11.3	0.5		1.1	53.1		0.0	1.2	0.0	0.7
Q Average	20.1	4.6		10.2	76.0		0.4	5.0	0.0	5.7
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.2	1.3	1.2
BOQ	24.1	5.7		12.4	91.1		0.5	6.2	0.0	7.1
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4		1.7	1.5	1.7	1.5
BOQ	28.2	6.9		14.7	106		0.7	7.6	0.0	8.6
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6	1.5		2.0	1.7	2.0	1.7
BOQ	30.3	7.8		16.0	114		0.8	8.5	0.0	9.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7	1.6		2.5	2.0	2.6	1.9
BOQ	32.5	9.1		17.7	122		1.0	9.9	0.0	11.0
QSRatio										
98th Percentile Output:										
fB%	1.7	2.3		1.9	1.7		3.1	2.2	3.2	2.2
BOQ	34.7	10.5		19.3	129		1.2	11.3	0.0	12.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/13	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2020 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	753	1506	0.76	0.50	24.8	C		
TR	1066	2132	0.04	0.50	11.5	B	24.0	C

LTR	1561	3122	0.05	0.50	11.6	B	11.6	B
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LTR	1220	3136	0.01	0.39	16.9	B	16.9	B
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LT	548	1410	0.12	0.39	18.1	B	297.7	F
R	616	1583	1.63	0.39	316.4	F		

Intersection Delay = 188.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	143	10	0	1	9	11	2	2	1	16	1	329
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	571	40			74			16			67	1002
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0			0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.952		1.000			1.000			0.937		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	514	36	0	1	36	43	3	3	2	62	1	1236
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	571	40	0	1	38	35	6	6	4	66	1	1002
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	571	40			74			16			67	1002
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.706	1.000			0.954			0.910		0.757	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1506	2132			3122			3136		1410	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	571	1506	# 0.38	0.50	753	0.76
Prot							
Perm							
Thru	TR	40	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	74	3122	0.02	0.50	1561	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3136	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	67	1410	0.05	0.39	548	0.12
Right	R	1002	1583	# 0.63	0.39	616	1.63

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.01$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.14$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.76	0.50	18.1	1.000	753	0.50	6.7	0.0	24.8	C		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	24.0	C
Westbound												
LTR	0.05	0.50	11.5	1.000	1561	0.50	0.1	0.0	11.6	B	11.6	B
Northbound												
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.12	0.39	17.6	1.000	548	0.50	0.4	0.0	18.1	B	297.7	F

R 1.63 0.39 27.5 1.000 616 0.50 288.9 0.0 316.4 F

Intersection delay = 188.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	571			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	74			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	14.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.42			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.706			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	66	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.985
Proportion of LT in opposing flow, PLTo	0.00	0.99	0.38	
Adjusted opposing flow rate, Vo (veh/h)	40	67	16	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.65	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	1.67	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	4.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	30.10	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.01	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.99	
EL1 (refer to Exhibit C16-3)	1.44	1.48	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.757	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	74	40	67	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.473	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	18.1	0.00	0.0	0.0	24.8
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.1
R	0.0	0.00	27.5	27.5	0.00	96.5	0.0	316.4
Intersection Delay			188.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	571	40			38			8			67	1002
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1506	2132			1639			1647			1410	1583
LnCapacity	753	1066			819			640			548	616
Flow Ratio	0.4	0.0			0.0			0.0			0.0	0.6
v/c Ratio	0.76	0.04			0.05			0.01			0.12	1.63
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.952			1.000			1.000			0.937	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	11.5	0.5			0.5			0.1			1.1	25.0
kB	0.9	1.1			1.0			0.8			0.7	0.8
Q2	2.5	0.0			0.0			0.0			0.1	50.2
Q Average	14.0	0.6			0.5			0.1			1.2	75.2
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	16.9	0.7			0.7			0.2			1.5	90.2
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.7			1.7			1.6	1.4
BOQ	19.9	0.9			0.9			0.2			1.9	105
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9			2.0			1.9	1.5
BOQ	21.4	1.1			1.0			0.3			2.2	113
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.5			2.6			2.4	1.6
BOQ	23.3	1.4			1.3			0.3			2.8	120
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			3.0			3.2			2.9	1.7
BOQ	25.1	1.7			1.6			0.4			3.4	128
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	286		24				2	279			687	549
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		19.0					31.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.60	0.32	22.0	C	21.6	C
R	473	1495	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1726 3340 0.18 0.52 8.0 A 8.0 A

Southbound

TR 1939 3752 0.70 0.52 12.7 B 12.7 B

Intersection Delay = 13.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	286		24				2	279		687	549	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	82		7				1	79		189	151	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	329		21					319			1358	
%InSharedLn												
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.444	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	286		24				2	279		687	549	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	329		21				2	317		755	603	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	329		21					319			1358	
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.444	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.926	0.926			0.990	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.933		
fLT	0.950				0.948	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1727	1495			3340	3752		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	329	1727	# 0.19	0.32	547	0.60
Prot							
Perm							
Thru							
Right	R	21	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	319	3340	0.10	0.52	1726	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1358	3752	# 0.36	0.52	1939	0.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.60	0.32	17.3	1.000	547	0.50	4.7	0.0	22.0	C	21.6	C
R	0.04	0.32	14.2	1.000	473	0.50	0.2	0.0	14.4	B		
Westbound												
Northbound												
LT	0.18	0.52	7.7	1.000	1726	0.50	0.2	0.0	8.0	A	8.0	A
Southbound												
TR	0.70	0.52	11.0	1.000	1939	0.50	1.7	0.0	12.7	B	12.7	B

Intersection delay = 13.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.006 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1358
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.89
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	14.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	5.59
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.948

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.03	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.453	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1358	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.006	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.444
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	17.3	0.00	0.0	0.0	22.0
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	8.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.0	0.00	0.0	0.0	12.7
	0.0						0.0	
Intersection Delay			13.5	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	329	21				167		713	
So	1900	1900				1900		1900	
No.Lanes	1 0	1 0	0 0 0			2 0	0	2 0	
SL	1727	1495				1754		1970	
LnCapacity	547	473				906		1018	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.60	0.04				0.18		0.70	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	4.6	0.2				1.5		9.0	
kB	0.5	0.5				0.8		0.7	
Q2	0.8	0.0				0.2		1.5	
Q Average	5.4	0.3				1.7		10.5	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	6.7	0.3				2.1		12.8	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	8.2	0.4				2.7		15.2	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.6	
BOQ	9.1	0.5				3.1		16.5	
QSRatio									
95th Percentile Output:									
fB%	1.9	2.5				2.3		1.7	
BOQ	10.5	0.7				3.9		18.2	
QSRatio									
98th Percentile Output:									
fB%	2.2	3.1				2.8		1.9	
BOQ	12.0	0.8				4.6		19.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	71	0		473	76		4			23	764	52
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.18	0.42	11.5	B	11.5	B
----	-----	------	------	------	------	---	------	---

Westbound

L	521	1251	1.02	0.42	61.5	E		
T	794	1906	0.11	0.42	11.0	B	54.5	D

Northbound

L	170	408	0.03	0.42	10.7	B	10.7	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2042	4901	0.45	0.42	13.3	B	13.3	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 28.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		71	0	473	76		4			23	764	52
% Heavy Veh		1	1	3	3		1			1	1	1
PHF		0.50	0.25	0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol		36	0	133	21		1			6	210	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		142		531	85		5				922	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.027	
Prop RTs		0.000			0.000						0.062	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.983			0.988		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	0		473	76		4			23	764	52
PHF	0.50	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	142	0		531	85		5			25	840	57
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	142			531	85		5			922		
Prop LTs	0.000			1.000	0.000		1.000			0.027		
Prop RTs	0.000			0.000						0.062		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.991	
fLT	1.000		0.656 1.000		0.232		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1251 1906		408		4901	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	142	1881	0.08	0.42	784	0.18
Right							
Westbound							
Prot							
Perm							
Left	L	531	1251	# 0.42	0.42	521	1.02
Prot							
Perm							
Thru	T	85	1906	0.04	0.42	794	0.11
Right							
Northbound							
Prot							
Perm							
Left	L	5	408	0.01	0.42	170	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	922	4901	# 0.19	0.42	2042	0.45
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.18	0.42	11.0	1.000	784	0.50	0.5	0.0	11.5	B	11.5	B	
Westbound													
L	1.02	0.42	17.5	1.000	521	0.50	44.0	0.0	61.5	E			
T	0.11	0.42	10.7	1.000	794	0.50	0.3	0.0	11.0	B	54.5	D	
Northbound													
L	0.03	0.42	10.3	1.000	170	0.50	0.3	0.0	10.7	B	10.7	B	
Southbound													
LTR	0.45	0.42	12.6	1.000	2042	0.50	0.7	0.0	13.3	B	13.3	B	

Intersection delay = 28.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		531	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		142	922	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		8.85	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		2.37	5.64	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.38	5.43	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		24.62	19.57	
n=Max(gq-gf)/2,0)		0.19	2.71	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.50	3.37	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.65	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	5.43	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.66	0.23	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.656	0.232	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT 0.000 0.000 0.027
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo 1.000 1.000 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
or $flt = [fm + 0.91(N - 1)] / N^*$
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	T	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	142		531	85	5			338	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	0	3
SL	1881		1251	1906	408			1799	
LnCapacity	784		521	794	170			749	
Flow Ratio	0.1		0.4	0.0	0.0			0.2	
v/c Ratio	0.18		1.02	0.11	0.03			0.45	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.988			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	1.5		8.9	0.9	0.0			4.0	
kB	0.7		0.5	0.7	0.2			0.7	
Q2	0.2		6.6	0.1	0.0			0.6	
Q Average	1.7		15.5	1.0	0.1			4.6	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3			1.2	
BOQ	2.1		18.6	1.2	0.1			5.7	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.4	1.6	1.7			1.5	
BOQ	2.7		21.9	1.6	0.1			7.0	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.5	1.9	2.0			1.7	
BOQ	3.1		23.6	1.8	0.1			7.8	
QSRatio									
95th Percentile Output:									
fB%	2.3		1.6	2.4	2.6			2.0	
BOQ	3.8		25.5	2.3	0.1			9.2	
QSRatio									
98th Percentile Output:									
fB%	2.8		1.8	2.9	3.2			2.3	
BOQ	4.6		27.4	2.8	0.2			10.6	
QSRatio									

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume	71
Peak-Hour Factor, PHF	0.71
Hourly Flow Rate, HFR	100
Percent Heavy Vehicles	--
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No

Minor Street:	Approach Movement	Northbound				Southbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume	560
Peak Hour Factor, PHF	0.88
Hourly Flow Rate, HFR	636
Percent Heavy Vehicles	1
Percent Grade (%)	0
Flared Approach: Exists?/Storage	/
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound				Southbound			
Movement	1	4	7	8	9	10	11	12		
Lane Config					R					

v (vph)	636
C(m) (vph)	958
v/c	0.66
95% queue length	5.24
Control Delay	15.8
LOS	C
Approach Delay	15.8
Approach LOS	C

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		71				
Peak-Hour Factor, PHF		0.71				
Peak-15 Minute Volume		25				
Hourly Flow Rate, HFR		100				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			560			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			159			
Hourly Flow Rate, HFR			636			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					100			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	100	
Potential Capacity	958	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	958	
Probability of Queue free St.	0.34	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.34
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			958			
Volume			636			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					636			
C(m) (vph)					958			
v/c					0.66			
95% queue length					5.24			
Control Delay					15.8			
LOS					C			
Approach Delay				15.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	106	39	274	83	0	0	0	0	24	101	13
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	180		457				80 70	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	180		457				80	70
Left-Turn	0		351				26	0
Right-Turn	48		0				0	14
Prop. Left-Turns	0.0		0.8				0.3	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.2
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	39	91	0	0	292	19	65	100	141	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	161		398		115		192	
% Heavy Veh	2		5		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	161		398		115	192		
Left-Turn	48		0		65	0		
Right-Turn	0		24		0	142		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	192	287	176	8	66	9	484	105	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	563	1608	1.00	0.35	57.8	E	49.1	D
R	560	1599	0.26	0.35	15.1	B		

Westbound

LTR	517	1477	0.18	0.35	14.3	B	14.3	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2299	4756	0.29	0.48	9.6	A	9.6	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 29.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	192	287	176	8	66	9	484	105	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	56	84	52	2	19	3	136	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		564	145		95			664				
%InSharedLn												
Prop LTs		0.401			0.095			0.819				
Prop RTs		0.000	1.000		0.105			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0						29.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	192	287	176	8	66	9	484	105	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	226	338	145	9	76	10	544	118	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	564 145			95			664					
Prop LTs	0.401			0.095			0.819					
Prop RTs	0.000 1.000			0.105			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		0.990			0.990				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.986			1.000				
fLT	0.827			0.925			0.961				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1608	1599		1477			4756				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 29.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	226	9	
Proportion of LT in LT lane group, PLT	0.401	0.095	0.819
Proportion of LT in opposing flow, PLTo	0.09	0.40	
Adjusted opposing flow rate, Vo (veh/h)	95	564	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.77	0.15	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.58	9.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	11.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	12.26	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	8.74	
n=Max(gq-gf)/2,0)	0.00	0.26	
PTHo=1-PLTo	0.91	0.60	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.40	0.09	
EL1 (refer to Exhibit C16-3)	1.52	2.45	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	0.51	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.93	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.827	0.925	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	12.26		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.584		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	95	564	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.401	0.095	0.819	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.105	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	0.3	0.0	57.8
R	0.0	0.00	19.5	13.9	0.00	0.0	0.0	15.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.3	0.00	0.0	0.0	9.6
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			29.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	564	145	95		243			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1608	1599	1477		1745			
LnCapacity	563	560	517		843			
Flow Ratio	0.4	0.1	0.1		0.1			
v/c Ratio	1.00	0.26	0.18		0.29			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.999		0.996		0.980			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	9.4	1.7	1.1		2.4			
kB	0.6	0.6	0.5		0.7			
Q2	6.4	0.2	0.1		0.3			
Q Average	15.8	1.9	1.2		2.7			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.3			
BOQ	19.1	2.4	1.6		3.4			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.6			
BOQ	22.4	3.1	2.0		4.3			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.8	1.9		1.8			
BOQ	24.1	3.5	2.3		4.9			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.3	2.4		2.2			
BOQ	26.0	4.4	2.9		6.0			
QSRatio								
98th Percentile Output:								
fB%	1.8	2.7	2.9		2.6			
BOQ	27.9	5.2	3.5		7.0			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	255		34				18	467		470	64	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds					Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds					Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	460	1724	0.65	0.27	26.5	C	26.5	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1098	1938	0.51	0.57	9.5	A	9.5	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1122	1980	0.52	0.57	9.5	A	9.5	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 13.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	255		34				18	467		470	64	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	66		9				5	136		128	17	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		301						564			581	
%InSharedLn												
Prop LTs		0.884						0.037			0.000	
Prop RTs		0.116						0.000			0.120	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	255		34				18	467		470	64	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	266		35				21	543		511	70	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		301						564			581	
Prop LTs		0.884						0.037			0.000	
Prop RTs		0.116						0.000			0.120	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.984						1.000			0.984		
fLT	0.958						0.973			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1724						1938			1980		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	301	1724	# 0.17	0.27	460	0.65
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	564	1938	0.29	0.57	1098	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	581	1980	# 0.29	0.57	1122	0.52
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.47

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.65	0.27	19.5	1.000	460	0.50	7.0	0.0	26.5	C	26.5	C
Westbound												
Northbound												
LT	0.51	0.57	7.9	1.000	1098	0.50	1.5	0.0	9.5	A	9.5	A
Southbound												
TR	0.52	0.57	8.0	1.000	1122	0.50	1.5	0.0	9.5	A	9.5	A

Intersection delay = 13.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		21	
Proportion of LT in LT lane group, PLT	0.884	0.037	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		581	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.35	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.68	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		16.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.48	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.49	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.973	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.48	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.191	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			581	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.037	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.120
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.5	0.00	0.0	0.0	26.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.9	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.0	0.00	0.0	0.0	9.5
	0.0						0.0	
Intersection Delay			13.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	301						564			581		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1724						1938			1980		
LnCapacity	460						1098			1122		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.65						0.51			0.52		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.5						5.7			5.9		
kB	0.5						0.8			0.8		
Q2	0.9						0.8			0.9		
Q Average	5.3						6.6			6.8		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.6						8.1			8.4		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	8.0						9.8			10.1		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	8.9						10.8			11.1		
QSRatio												
95th Percentile Output:												
fB%	1.9						1.9			1.9		
BOQ	10.4						12.3			12.7		
QSRatio												
98th Percentile Output:												
fB%	2.2						2.1			2.1		
BOQ	11.8						13.8			14.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	146		86				23	610		423	292	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								21	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 573 1718 0.50 0.33 18.9 B 18.9 B

Westbound

Northbound

LT 890 1780 0.83 0.50 20.2 C 20.2 C

Southbound

TR 963 1925 0.78 0.50 18.0 B 18.0 B

Intersection Delay = 19.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	146		86				23	610		423	292	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	46		27				7	177		115	79	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		289						736			755	
%InSharedLn												
Prop LTs		0.630						0.037			0.000	
Prop RTs	0.370						0.000			0.391		
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	146		86				23	610		423	292	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	182		107				27	709		460	295	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		289						736			755	
Prop LTs		0.630						0.037			0.000	
Prop RTs		0.370						0.000			0.391	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.950						1.000			0.947		
fLT	0.969						0.962			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1718						1780			1925		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	289	1718	# 0.17	0.33	573	0.50
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	736	1780	# 0.41	0.50	890	0.83
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	755	1925	0.39	0.50	963	0.78
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.58

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.50	0.33	16.0	1.000	573	0.50	2.9	0.0	18.9	B	18.9	B
Westbound												
Northbound												
LT	0.83	0.50	12.8	1.000	890	0.50	7.4	0.0	20.2	C	20.2	C
Southbound												
TR	0.78	0.50	12.3	1.000	963	0.50	5.6	0.0	18.0	B	18.0	B

Intersection delay = 19.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gq > gf$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		27	
Proportion of LT in LT lane group, PLT	0.630	0.037	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		755	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.45	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		12.58	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		12.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		11.32	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.17	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.95	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.962	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			11.32	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.377	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		755	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.630		0.037	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.370	0.391
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.0	0.00	0.0	0.0	18.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	12.8	0.00	0.0	0.0	20.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	12.3	0.00	0.0	0.0	18.0
	0.0						0.0	
Intersection Delay			19.0	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	289						736			755		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1718						1780			1925		
LnCapacity	573						890			963		
Flow Ratio	0.2						0.4			0.4		
v/c Ratio	0.50						0.83			0.78		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.9						10.5			10.3		
kB	0.5						0.7			0.7		
Q2	0.5						2.8			2.4		
Q Average	4.4						13.2			12.8		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.5						16.0			15.5		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.7						18.8			18.2		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.5			1.5		
BOQ	7.5						20.3			19.7		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.7			1.7		
BOQ	8.9						22.1			21.5		
QSRatio												
98th Percentile Output:												
fB%	2.3						1.8			1.8		
BOQ	10.2						23.9			23.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		179	282	482	274	104	206		499	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	53.2	D
R	220	1652	0.85	0.13	53.9	D		
Westbound								
LTR	1330	4694	0.89	0.28	25.4	C	25.4	C
Northbound								
L	124	373	0.91	0.33	76.2	E		
T	616	1848	0.36	0.33	16.7	B	36.7	D
Southbound								
TR	670	2010	0.87	0.33	31.2	C	31.2	C

Intersection Delay = 30.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		179	282	482	274	104	206		499	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		47	80	137	78	28	56		143	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		188		1179		113	224			580	
%InSharedLn												
Prop LTs					0.271		1.000	0.000			0.000	
Prop RTs			1.000		0.264			0.000			0.010	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds	X	
WB	Left			P			SB	Left		
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds			X				Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		8.0	17.0					20.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		179	282	482	274	104	206		499	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		188	320	548	311	113	224		574	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	4		188		1179		113	224			580	
Prop LTs					0.271		1.000	0.000			0.000	
Prop RTs			1.000		0.264			0.000			0.010	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	R
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.990	0.990	0.980	0.980	0.962	0.962
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.972	0.972
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.960	0.960		1.000	0.999	0.999
fLT	0.950		0.987	0.987	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4694	4694	373	1848	2010	2010
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	188	1652	# 0.11	0.13	220	0.85
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1179	4694	# 0.25	0.28	1330	0.89
Right							
Northbound							
Prot							
Perm							
Left	L	113	373	# 0.30	0.33	124	0.91
Prot							
Perm							
Thru	T	224	1848	0.12	0.33	616	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	580	2010	0.29	0.33	670	0.87
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.67
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	53.2	D	
R	0.85	0.13	25.4	1.000	220	0.50	28.4	0.0	53.9	D			
Westbound													
LTR	0.89	0.28	20.6	1.000	1330	0.50	4.8	0.0	25.4	C	25.4	C	
Northbound													
L	0.91	0.33	19.2	1.000	124	0.50	57.1	0.0	76.2	E	36.7	D	
T	0.36	0.33	15.2	1.000	616	0.50	1.5	0.0	16.7	B			
Southbound													
TR	0.87	0.33	18.7	1.000	670	0.50	12.4	0.0	31.2	C	31.2	C	

Intersection delay = 30.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			113	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			580	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.88	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.67	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			13.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			6.89	
n=Max(gq-gf)/2,0)			6.56	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.24	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.271 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			13.11	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.656	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			580	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.264	0.010
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	25.4	0.00	0.0	0.0	53.9
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.6	0.00	0.0	0.0	25.4
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	19.2	0.00	0.0	0.0	76.2
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.7	0.00	0.0	0.0	31.2
	0.0						0.0	
Intersection Delay			30.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	188		432		113	224		580
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1723		373	1848		2010
LnCapacity	222	220		488		124	616		670
Flow Ratio	0.0	0.1		0.3		0.3	0.1		0.3
v/c Ratio	0.02	0.85		0.89		0.91	0.36		0.87
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	3.1		6.9		1.8	2.8		9.1
kB	0.3	0.3		0.3		0.2	0.6		0.6
Q2	0.0	1.2		1.6		1.1	0.3		2.9
Q Average	0.1	4.2		8.5		2.9	3.2		11.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.1	5.2		10.4		3.6	4.0		14.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.4
BOQ	0.1	6.4		12.4		4.5	4.9		17.0
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.5
BOQ	0.1	7.2		13.5		5.1	5.6		18.5
QSRatio									
95th Percentile Output:									
fB%	2.6	2.0		1.8		2.2	2.1		1.7
BOQ	0.2	8.6		15.2		6.2	6.7		20.2
QSRatio									
98th Percentile Output:									
fB%	3.2	2.3		2.0		2.5	2.5		1.8
BOQ	0.2	9.9		16.8		7.3	7.9		21.9
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	10	20	6				9	300	126	331	577	51
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 460 1623 0.13 0.28 16.5 B 16.5 B

Westbound

Northbound

LTR 956 1738 0.49 0.55 10.0+ B 10.0+ B

Southbound

L 488 887 0.73 0.55 15.5 B
 TR 986 1793 0.67 0.55 11.7 B 13.0 B

Intersection Delay = 12.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	20	6				9	300	126	331	577	51
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				3	82	34	89	155	14
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		58						473		356	662	
%InSharedLn												
Prop LTs		0.276						0.021		1.000	0.000	
Prop RTs		0.172						0.290			0.063	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10	20	6				9	300	126	331	577	51
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
Adj flow	16	32	10				10	326	137	356	620	42
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	58						473			356	662	
Prop LTs	0.276						0.021			1.000	0.000	
Prop RTs	0.172						0.290			0.063		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.980	0.980	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							0.992			1.000	0.972	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.977							0.961				0.990	
fLT	0.986							0.987			0.476	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1623							1738			887	1793	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	58	1623	# 0.04	0.28	460	0.13
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	473	1738	0.27	0.55	956	0.49
Right							
Southbound							
Prot							
Perm							
Left	L	356	887	# 0.40	0.55	488	0.73
Prot							
Perm							
Thru	TR	662	1793	0.37	0.55	986	0.67
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.13	0.28	16.0	1.000	460	0.50	0.6	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.49	0.55	8.3	1.000	956	0.50	1.7	0.0	10.0+	B	10.0+	B
Southbound												
L	0.73	0.55	10.1	1.000	488	0.50	5.4	0.0	15.5	B		
TR	0.67	0.55	9.6	1.000	986	0.50	2.1	0.0	11.7	B	13.0	B

Intersection delay = 12.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				356
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				473
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.93
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.88
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				5.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.78
n=Max(gq-gf)/2,0)				2.61
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.03
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.56
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdifff=max(gq-gf,0)				5.22
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.48
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.476

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		10	
Proportion of LT in LT lane group, PLT	0.276	0.021	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		662	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.17	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		20.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.45	
gq, (see Exhibit C16-4,5,6,7,8)		8.20	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		12.15	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02	
EL1 (refer to Exhibit C16-3)		2.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.987	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			8.20	5.22
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.249	0.158
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			662	473
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.021	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.172	0.290	0.063
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.0	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	10.0+
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	10.1	0.00	0.0	0.0	15.5
TR	0.0	0.00	13.5	9.6	0.00	0.0	0.0	11.7
	0.0						0.0	

Intersection Delay	12.3	sec/veh	Intersection LOS	B
--------------------	------	---------	------------------	---

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	58						473			356	662	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	0	
SL	1623						1738			887	1793	
LnCapacity	460						956			488	986	
Flow Ratio	0.0						0.3			0.4	0.4	
v/c Ratio	0.13						0.49			0.73	0.67	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.922				0.564	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	0.7						4.9			4.5	7.9	
kB	0.5						0.8			0.3	0.5	
Q2	0.1						0.7			0.8	1.0	
Q Average	0.8						5.6			5.2	8.8	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	1.0						6.9			6.4	10.7	
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.5	1.5	
BOQ	1.3						8.4			7.9	12.8	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7	1.6	
BOQ	1.5						9.3			8.7	14.0	
QSRatio												
95th Percentile Output:												
fB%	2.5						1.9			2.0	1.8	
BOQ	1.9						10.8			10.2	15.6	
QSRatio												
98th Percentile Output:												
fB%	3.0						2.2			2.2	2.0	
BOQ	2.4						12.3			11.6	17.3	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	13	20	266	29	109	18	319	174	93	454	10
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 634 1427 0.09 0.44 14.7 B 14.7 B

Westbound

L 560 1259 0.55 0.44 21.8 C
 T 792 1783 0.04 0.44 14.2 B 19.7 B
 R 585 1316 0.21 0.44 16.1 B

Northbound

LTR 733 1650 0.76 0.44 25.8 C 25.8 C

Southbound

LTR 623 1401 1.03 0.44 49.7 D 49.7 D

Intersection Delay = 32.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	13	20	266	29	109	18	319	174	93	454	10
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	5	7	76	8	31	5	87	47	27	130	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		306	33	125		556			640	
%InSharedLn												
Prop LTs		0.158		1.000	0.000			0.036			0.167	
Prop RTs		0.509			0.000	1.000		0.340			0.017	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	13	20	266	29	109	18	319	174	93	454	10
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	19	29	306	33	125	20	347	189	107	522	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	57			306	33	125	556			640		
Prop LTs	0.158			1.000	0.000		0.036			0.167		
Prop RTs	0.509			0.000 1.000			0.340			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.954		0.998		
fLT	0.976		0.720	1.000		0.969		0.757		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.996		
fRpb	0.972		1.000 1.000			0.981		1.000		
S	1427		1259	1783	1316	1650		1401		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1427	0.04	0.44	634	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	306	1259	# 0.24	0.44	560	0.55
Prot							
Perm							
Thru	T	33	1783	0.02	0.44	792	0.04
Right	R	125	1316	0.09	0.44	585	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	556	1650	0.34	0.44	733	0.76
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	640	1401	# 0.46	0.44	623	1.03
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	634	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.55	0.44	18.3	1.000	560	0.50	3.4	0.0	21.8	C		
T	0.04	0.44	14.2	1.000	792	0.50	0.1	0.0	14.2	B	19.7	B
R	0.21	0.44	15.3	1.000	585	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.76	0.44	21.0	1.000	733	0.50	4.9	0.0	25.8	C	25.8	C
Southbound												
LTR	1.03	0.44	25.0	1.000	623	0.50	24.7	0.0	49.7	D	49.7	D

Intersection delay = 32.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gq > gf$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	107
Proportion of LT in LT lane group, PLT	0.158	0.000	0.036
Proportion of LT in opposing flow, PLTo	0.00	0.17	0.04
Adjusted opposing flow rate, Vo (veh/h)	33	640	556
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.82	16.00	13.90
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	17.9	3.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	16.91	14.68
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	22.06	25.32
n=Max(gq-gf)/2,0)	0.00	0.00	5.79
PTHo=1-PLTo	1.00	0.83	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.17
EL1 (refer to Exhibit C16-3)	1.42	2.64	2.43
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.31
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	11.58
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.976	0.969	0.757

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	16.91	14.68
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.423	0.367
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	33	57	640	556
OCCr	0.000	0.052	0.000	0.021
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.979
Proportion of left turns, PLT	0.158	1.000	0.036	0.167
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.996
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.509	1.000	0.340	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.972	1.000	0.981	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.3	0.00	0.0	0.0	21.8
T	0.0	0.00	25.0	14.2	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	21.0	0.00	0.0	0.0	25.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	4.3	0.0	49.7
	0.0						0.0	
Intersection Delay			32.7	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	57		306	33	125	556		640	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1427		1259	1783	1316	1650		1401	
LnCapacity	634		560	792	585	733		623	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.5	
v/c Ratio	0.09		0.55	0.04	0.21	0.76		1.03	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.905			0.663		0.229	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.8		5.6	0.5	1.9	11.6		16.0	
kB	0.8		0.7	0.9	0.7	0.6		0.2	
Q2	0.1		0.8	0.0	0.2	1.8		5.1	
Q Average	0.9		6.4	0.5	2.1	13.4		21.1	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	1.2		7.9	0.7	2.7	16.2		25.3	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	1.5		9.5	0.8	3.4	19.1		29.6	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.5		1.5	
BOQ	1.7		10.5	1.0	3.9	20.6		31.8	
QSRatio									
95th Percentile Output:									
fB%	2.4		1.9	2.5	2.3	1.7		1.6	
BOQ	2.2		12.1	1.3	4.8	22.4		34.0	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.8		1.7	
BOQ	2.7		13.6	1.5	5.7	24.2		36.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 6/19/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	210		252	227	231		144		217			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	940	1880	0.52	0.50	17.2	B	17.2	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	461	922	1.20	0.50	129.7	F	129.7	F
----	-----	-----	------	------	-------	---	-------	---

Northbound

LR	557	1433	0.97	0.39	56.3	E	56.3	E
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 69.7 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		210	252	227	231		144		217			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		64	77	68	70		54		81			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59						0			
Adj Flow		491			551			539				
%InSharedLn												
Prop LTs		0.000			0.495			0.399				
Prop RTs		0.479			0.000			0.601				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		210	252	227	231		144		217			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		256	235	273	278		215		324			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		491			551			539				
Prop LTs		0.000			0.495			0.399				
Prop RTs		0.479			0.000			0.601				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.935			1.000			0.919					
fLT	1.000			0.462			0.980					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1880			922			1433					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.52	0.50	15.2	1.000	940	0.50	1.9	0.0	17.2	B	17.2	B
Westbound												
LT	1.20	0.50	22.5	1.000	461	0.50	107.2	0.0	129.7	F	129.7	F
Northbound												
LR	0.97	0.39	26.9	1.000	557	0.50	29.4	0.0	56.3	E	56.3	E
Southbound												

Intersection delay = 69.7 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	273		
Proportion of LT in LT lane group, PLT	0.000	0.495	0.399
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	491		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	6.83		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.27		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	11.01		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	33.99		
n=Max(gq-gf)/2,0)	5.51		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.50		
EL1 (refer to Exhibit C16-3)	2.28		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.46		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.462		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	15.2	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	22.5	0.00	22.5	0.0	129.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	26.9	0.00	0.0	0.0	56.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			69.7	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	TR			LT			LR					
Init Queue	0.0			0.0			0.0					
Flow Rate	491			551			539					
So	1900			1900			1900					
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	
SL	1880			922			1433					
LnCapacity	940			461			557					
Flow Ratio	0.3			0.6			0.4					
v/c Ratio	0.52			1.20			0.97					
Grn Ratio	0.50			0.50			0.39					
I Factor	0.927			0.989			0.917					
AT or PVG	3			3			3					
Pltn Ratio	1.00			1.00			1.00					
PF2	1.00			1.00			1.00					
Q1	8.3			13.8			13.2					
kB	1.0			0.7			0.7					
Q2	1.1			14.4			5.8					
Q Average	9.4			28.2			19.0					
Q Spacing	25.0			25.0			25.0					
Q Storage	0			0			0					
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.2			1.2					
BOQ	11.4			33.8			22.9					
QSRatio												
85th Percentile Output:												
fB%	1.4			1.4			1.4					
BOQ	13.6			39.5			26.7					
QSRatio												
90th Percentile Output:												
fB%	1.6			1.5			1.5					
BOQ	14.8			42.3			28.7					
QSRatio												
95th Percentile Output:												
fB%	1.8			1.6			1.6					
BOQ	16.5			45.2			30.8					
QSRatio												
98th Percentile Output:												
fB%	1.9			1.7			1.7					
BOQ	18.1			48.0			33.0					
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrotts Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	27	33	24	52	17	41	12	291	50	29	331	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination			1	2	3	4	5	6	7	8
EB	Left			P			NB	Left	P	
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds			X				Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		15.0	7.0					23.0	0.0	
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 238 2037 0.88 0.12 59.8 E 59.8 E

Westbound

LTR 500 1998 0.28 0.25 19.6 B 19.6 B

Northbound

LTR 765 1996 0.50 0.38 16.5 B 16.5 B

Southbound

LTR 735 1917 0.60 0.38 18.4 B 18.4 B

Intersection Delay = 25.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	27	33	24	52	17	41	12	291	50	29	331	28
% Heavy Veh	0	0	0	0	0	0	3	3	3	5	5	5
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
PK 15 Vol	17	21	15	17	5	13	3	79	14	8	94	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		209			142			383			441	
%InSharedLn												
Prop LTs		0.321			0.472			0.034			0.075	
Prop RTs		0.287			0.373			0.141			0.073	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	27	33	24	52	17	41	12	291	50	29	331	28
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
Adj flow	67	82	60	67	22	53	13	316	54	33	376	32
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	209			142			383			441		
Prop LTs	0.321			0.472			0.034			0.075		
Prop RTs	0.287			0.373			0.141			0.073		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	1.000			1.000			0.971			0.952		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.961			0.950			0.981			0.990		
fLT	0.984			0.977			0.981			0.952		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2037			1998			1996			1917		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	209	2037	# 0.10	0.12	238	0.88
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	142	1998	# 0.07	0.25	500	0.28
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	383	1996	0.19	0.38	765	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	441	1917	# 0.23	0.38	735	0.60
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.40
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.88	0.12	26.1	1.000	238	0.50	33.7	0.0	59.8	E	59.8	E	
Westbound													
LTR	0.28	0.25	18.2	1.000	500	0.50	1.4	0.0	19.6	B	19.6	B	
Northbound													
LTR	0.50	0.38	14.1	1.000	765	0.50	2.3	0.0	16.5	B	16.5	B	
Southbound													
LTR	0.60	0.38	14.8	1.000	735	0.50	3.6	0.0	18.4	B	18.4	B	

Intersection delay = 25.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			13	33
Proportion of LT in LT lane group, PLT	0.321	0.472	0.034	0.075
Proportion of LT in opposing flow, PLTo			0.07	0.03
Adjusted opposing flow rate, Vo (veh/h)			441	383
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.22	0.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.35	6.38
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			11.6	7.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			8.53	7.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.44	15.26
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.93	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.07
EL1 (refer to Exhibit C16-3)			2.17	2.05
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.09
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.981	0.952

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.15
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.311
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				383
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.075
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.287	0.141
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	26.1	0.00	0.0	0.0	59.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.2	0.00	0.0	0.0	19.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.1	0.00	0.0	0.0	16.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.8	0.00	0.0	0.0	18.4
	0.0						0.0	
Intersection Delay			25.3	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	209		142		383		441	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0 0	0 1 0	0 0	0 1 0	0 0	0 1 0	0 0
SL	2037		1998		1996		1917	
LnCapacity	238		500		765		735	
Flow Ratio	0.1		0.1		0.2		0.2	
v/c Ratio	0.88		0.28		0.50		0.60	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	3.4		1.9		4.9		5.9	
kB	0.3		0.5		0.7		0.7	
Q2	1.6		0.2		0.7		1.0	
Q Average	5.0		2.1		5.6		6.9	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.2		1.2	
BOQ	6.2		2.7		6.9		8.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.5		1.5	
BOQ	7.6		3.4		8.4		10.2	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.7		1.6	
BOQ	8.4		3.9		9.3		11.2	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.3		1.9		1.9	
BOQ	9.9		4.8		10.7		12.8	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.7		2.2		2.1	
BOQ	11.3		5.7		12.2		14.3	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			330	55		19	388	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			358	59		21	440	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		119		22				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		158		29				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1		4	7	8	9		10	11	12
Lane Config			LT		LR					
v (vph)			21		187					
C(m) (vph)			1126		343					
v/c			0.02		0.55					
95% queue length			0.06		3.10					
Control Delay			8.3		27.4					
LOS			A		D					
Approach Delay					27.4					
Approach LOS					D					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		330	55	19	388	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		90	15	5	110	
Hourly Flow Rate, HFR		358	59	21	440	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R

Volume	119		22			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	40		7			
Hourly Flow Rate, HFR	158		29			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		440
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		417	870		388			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	388	
Potential Capacity	658	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	658	
Probability of Queue free St.	0.96	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	417	
Potential Capacity	1126	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1126	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.97	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	870	
Potential Capacity	321	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.94
Movement Capacity	315	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 870
Potential Capacity 321
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.97
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.94
Movement Capacity 315

Results for Two-stage process:

a
y
C t 315

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	158		29			
Movement Capacity (vph)	315		658			
Shared Lane Capacity (vph)		343				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	315		658			
Volume	158		29			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		343				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		21		187				
C(m) (vph)		1126		343				
v/c		0.02		0.55				
95% queue length		0.06		3.10				
Control Delay		8.3		27.4				
LOS		A		D				
Approach Delay				27.4				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		440
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.97
d(M,LT), Delay for stream 1 or 4		8.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	10	5	430	27	443	5	215	421	307	228	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1743	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	545	1309	0.91	0.42	35.7	D	34.8	C
R	539	1293	0.89	0.42	33.8	C		

Northbound

LTR	747	1792	0.94	0.42	36.2	D	36.2	D
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	310	745	1.90	0.42	433.0	F	433.0	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 137.5 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	430	27	443	5	215	421	307	228	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	117	7	120	2	59	116	84	63	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			496	482		704			588	
%InSharedLn												
Prop LTs		0.000			0.942			0.007			0.573	
Prop RTs		0.313			0.000	1.000		0.658			0.000	
Peds Bikes		0			0	0		0			0	0
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	430	27	443	5	215	421	307	228	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	467	29	482	5	236	463	337	251	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			496 482			704			588		
Prop LTs	0.000			0.942			0.007			0.573		
Prop RTs	0.313			0.000 1.000			0.658			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.958			1.000 0.850			0.911			1.000		
fLT	1.000			0.727			0.996			0.359		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1309 1293			1792			745		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	496	1309	# 0.38	0.42	545	0.91
Right	R	482	1293	0.37	0.42	539	0.89
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	704	1792	0.39	0.42	747	0.94
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	588	745	# 0.79	0.42	310	1.90
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.17$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.40$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.91	0.42	16.4	1.000	545	0.50	19.2	0.0	35.7	D	34.8	C
R	0.89	0.42	16.3	1.000	539	0.50	17.5	0.0	33.8	C		
Northbound												
LTR	0.94	0.42	16.8	1.000	747	0.50	19.4	0.0	36.2	D	36.2	D
Southbound												
LTR	1.90	0.42	17.5	1.000	310	0.50	415.5	0.0	433.0	F	433.0	F

Intersection delay = 137.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	467	5	337
Proportion of LT in LT lane group, PLT	0.000	0.942	0.007	0.573
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.57	0.01
Adjusted opposing flow rate, Vo (veh/h)	496	16	588	704
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.78	0.08	5.62
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.27	0.27	9.80	11.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.95	0.00	10.88	13.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.05	25.00	9.12	11.78
n=Max(gq-gf)/2,0)	4.48	0.00	0.00	6.61
PTHo=1-PLTo	0.06	1.00	0.43	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.57
EL1 (refer to Exhibit C16-3)	2.29	1.40	2.51	2.81
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.06		1.00	6.48
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.16	0.08	0.13
gdifff=max(gq-gf,0)	8.95	0.00	0.00	13.22
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.73	1.00	0.36
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.727	0.996	0.359

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.95		10.88	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.358		0.435	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	496		588	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.4	0.00	0.0	0.0	35.7
R	0.0	0.00	17.5	16.3	0.00	0.0	0.0	33.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	16.8	0.00	0.0	0.0	36.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	69.5	0.0	433.0
	0.0						0.0	
Intersection Delay			137.5	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	16		496	482	704		588	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0	0	1 1	0	1 0	0	1 0	
SL	1743		1309	1293	1792		745	
LnCapacity	726		545	539	747		310	
Flow Ratio	0.0		0.4	0.4	0.4		0.8	
v/c Ratio	0.02		0.91	0.89	0.94		1.90	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000		0.849		0.861		1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.2		7.8	7.5	11.3		9.8	
kB	0.7		0.5	0.5	0.6		0.4	
Q2	0.0		3.2	2.9	5.1		35.5	
Q Average	0.2		10.9	10.3	16.3		45.3	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.2		1.2	
BOQ	0.2		13.3	12.5	19.7		54.4	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.4	1.4		1.4	
BOQ	0.3		15.7	14.9	23.1		63.5	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.5		1.5	
BOQ	0.3		17.0	16.1	24.8		68.0	
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	1.7	1.6		1.6	
BOQ	0.4		18.7	17.8	26.8		72.5	
QSRatio								
98th Percentile Output:								
fB%	3.1		1.9	1.9	1.8		1.7	
BOQ	0.5		20.5	19.5	28.7		77.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				450		9		633			663	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2027 0.79 0.33 22.7 C 22.7 C

Northbound

T 1026 2051 0.68 0.50 14.5 B 14.5 B

Southbound

T 1027 2054 0.71 0.50 13.2 B 13.2 B

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				450		9	633			663		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				131		3	174			182		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					533		696			729		
%InSharedLn												
Prop LTs					0.981		0.000			0.000		
Prop RTs					0.019		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				450		9	633			663		
PHF				0.86		0.86	0.91			0.91		
Adj flow				523		10	696			729		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					533			696			729	
Prop LTs					0.981			0.000			0.000	
Prop RTs					0.019			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.997			1.000			1.000	
fLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2027			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	533	2027	# 0.26	0.33	676	0.79
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	696	2051	0.34	0.50	1026	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	729	2054	# 0.35	0.50	1027	0.71
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.62

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.79	0.33	18.1	1.000	676	0.50	4.6	0.0	22.7	C	22.7	C	
Northbound													
T	0.68	0.50	11.3	1.000	1026	0.50	3.1	0.0	14.5	B	14.5	B	
Southbound													
T	0.71	0.50	11.6	1.000	1027	0.50	1.6	0.0	13.2	B	13.2	B	

Intersection delay = 16.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.981 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		633	269			180	933	
Peak-Hour Factor, PHF		0.91	0.91			0.91	0.91	
Hourly Flow Rate, HFR		695	295			197	1025	
Percent Heavy Vehicles		--	--			6	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		LT						
v (vph)		197						
C(m) (vph)		683						
v/c		0.29						
95% queue length		1.19						
Control Delay		12.4						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume	633	269	180	933		
Peak-Hour Factor, PHF	0.91	0.91	0.91	0.91		
Peak-15 Minute Volume	174	74	49	256		
Hourly Flow Rate, HFR	695	295	197	1025		
Percent Heavy Vehicles	--	--	6	--	--	
Median Type/Storage	Undivided		/			
RT Channelized?						
Lanes	1	0		0	1	
Configuration		TR		LT		
Upstream Signal?	No				No	

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume					
Peak Hour Factor, PHF					
Peak-15 Minute Volume					
Hourly Flow Rate, HFR					
Percent Heavy Vehicles					
Percent Grade (%)	0			0	
Flared Approach: Exists?/Storage			/		/
RT Channelized?					
Lanes					
Configuration					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		1025
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		990						
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	990	
Potential Capacity	683	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	683	
Probability of Queue free St.	0.71	1.00
Maj L-Shared Prob Q free St.	0.27	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.27	0.27
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.71	0.71
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.27 0.27
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.71 0.71
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT						
v (vph)		197						
C(m) (vph)		683						
v/c		0.29						
95% queue length		1.19						
Control Delay		12.4						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.71
v(il), Volume for stream 2 or 5		1025
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.27
d(M,LT), Delay for stream 1 or 4		12.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		9.0

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				107		232	652	93		165	743	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 392 1471 0.97 0.27 59.4 E 59.4 E

Northbound

TR 1132 1998 0.72 0.57 12.7 B 12.7 B

Southbound

LT 624 1102 1.60 0.57 284.1 F 284.1 F

Intersection Delay = 144.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				107		232	652	93		165	743	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				30		65	179	26		45	204	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					381			818			997	
%InSharedLn												
Prop LTs					0.315			0.000			0.182	
Prop RTs					0.685			0.125			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				107		232	652	93		165	743	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				120		261	716	102		181	816	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					381			818			997	
Prop LTs					0.315			0.000			0.182	
Prop RTs					0.685			0.125			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.908			0.983			1.000	
fLT					0.984			1.000			0.542	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1471			1998			1102	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	381	1471	# 0.26	0.27	392	0.97
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	818	1998	0.41	0.57	1132	0.72
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	997	1102	# 0.90	0.57	624	1.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.16
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.40

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.97	0.27	21.8	1.000	392	0.50	37.6	0.0	59.4	E	59.4	E
----	------	------	------	-------	-----	------	------	-----	------	---	------	---

Northbound

TR	0.72	0.57	9.5	1.000	1132	0.50	3.2	0.0	12.7	B	12.7	B
----	------	------	-----	-------	------	------	-----	-----	------	---	------	---

Southbound

LT	1.60	0.57	13.0	1.000	624	0.50	271.1	0.0	284.1	F	284.1	F
----	------	------	------	-------	-----	------	-------	-----	-------	---	-------	---

Intersection delay = 144.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			181
Proportion of LT in LT lane group, PLT	0.315	0.000	0.182
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			818
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.02
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.63
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			9.90
gu=g-gq if gq>=gf, or = g-gf if gq<gf			24.10
n=Max(gq-gf)/2,0)			4.41
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.18
EL1 (refer to Exhibit C16-3)			3.13
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.542

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				9.90
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.291
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				818
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.182
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.685	0.125
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.8	0.00	0.0	0.0	59.4
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.5	0.00	0.0	0.0	12.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	93.3	0.0	284.1
	0.0						0.0	
Intersection Delay			144.0	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	103	49	124	31	92	88	174	779	144	69	619	101
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	477	1384	0.74	0.34	31.5	C	31.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	536	1557	0.54	0.34	27.6	C	27.6	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	268	493	0.71	0.54	23.6	C		
TR	1067	1960	0.94	0.54	29.9	C	28.9	C

Southbound

LTR	922	1694	0.91	0.54	32.1	C	32.1	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 30.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	103	49	124	31	92	88	174	779	144	69	619	101
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	33	16	40	11	32	30	47	212	39	19	168	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		354			289		189	1004			836	
%InSharedLn												
Prop LTs		0.373			0.145		1.000	0.000			0.090	
Prop RTs		0.449			0.419			0.156			0.105	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	103	49	124	31	92	88	174	779	144	69	619	101
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	132	63	159	42	126	121	189	847	157	75	673	88
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	354			289			189 1004			836		
Prop LTs	0.373			0.145			1.000 0.000			0.090		
Prop RTs	0.449			0.419			0.156			0.105		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.939			0.943			0.977			0.984		
fLT	0.684			0.912			0.281 1.000			0.540		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1384			1557			493 1960			1694		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	354	1384	# 0.26	0.34	477	0.74
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	289	1557	0.19	0.34	536	0.54
Right							
Northbound							
Prot							
Perm							
Left	L	189	493	0.38	0.54	268	0.71
Prot							
Perm							
Thru	TR	1004	1960	# 0.51	0.54	1067	0.94
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	836	1694	0.49	0.54	922	0.91
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.77
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.74	0.34	26.0	1.000	477	0.50	5.5	0.0	31.5	C	31.5	C	
Westbound													
LTR	0.54	0.34	23.7	1.000	536	0.50	3.9	0.0	27.6	C	27.6	C	
Northbound													
L	0.71	0.54	15.2	1.000	268	0.50	8.5	0.0	23.6	C			
TR	0.94	0.54	19.1	1.000	1067	0.50	10.7	0.0	29.9	C	28.9	C	
Southbound													
LTR	0.91	0.54	18.4	1.000	922	0.50	13.7	0.0	32.1	C	32.1	C	

Intersection delay = 30.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			189	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.09	
Adjusted opposing flow rate, Vo (veh/h)			836	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			4.72	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.98	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			8.23	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.77	
n=Max(gq-gf)/2,0)			4.11	
PTHo=1-PLTo			0.91	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.96	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.57	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			8.23	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.28	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.281	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	132	42	75
Proportion of LT in LT lane group, PLT	0.373	0.145	0.000
Proportion of LT in opposing flow, PLTo	0.15	0.37	0.00
Adjusted opposing flow rate, Vo (veh/h)	289	354	1004
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	3.30	1.05	1.88
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.22	8.85	25.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	7.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	9.25	11.63	46.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.75	19.37	2.29
n=Max(gq-gf)/2,0)	4.62	1.93	19.72
PTHo=1-PLTo	0.85	0.63	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.15	0.45
EL1 (refer to Exhibit C16-3)	1.86	1.99	3.75
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.55	1.59	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	9.24	3.86	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.68	0.91	0.17
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.684	0.912	0.540

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	9.25	11.63	8.23	46.71
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.298	0.375	0.168	0.953
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	289	354	836	1004
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.373	0.145	1.000	0.090
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.449	0.419	0.156	0.105
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	26.0	0.00	0.0	0.0 0.0 0.0	31.5
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	23.7	0.00	0.0	0.0 0.0 0.0	27.6
Northbound								
L	0.0	0.00	20.5	15.2	0.00	0.0	0.0	23.6
TR	0.0 0.0	0.00	20.5	19.1	0.00	0.0	0.0 0.0	29.9
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	18.4	0.00	0.0	0.0 0.0 0.0	32.1
Intersection Delay			30.1	sec/veh	Intersection LOS			C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	354		289		189	1004	439	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 0	1 0	0	1 1 0	0 0	2 0	
SL	1384		1557		493	1960	889	
LnCapacity	477		536		268	1067	484	
Flow Ratio	0.3		0.2		0.4	0.5	0.5	
v/c Ratio	0.74		0.54		0.71	0.94	0.91	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.8		5.8		3.5	23.4	9.9	
kB	0.4		0.7		0.3	0.7	0.7	
Q2	1.0		0.8		0.6	6.0	3.8	
Q Average	8.8		6.7		4.1	29.5	13.7	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	10.7		8.2		5.1	35.4	16.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.5	1.4	1.4	
BOQ	12.7		9.8		6.2	41.3	19.4	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.7	1.5	1.5	
BOQ	13.9		10.9		7.0	44.3	21.0	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.9		2.0	1.6	1.7	
BOQ	15.6		12.4		8.3	47.3	22.8	
QSRatio								
98th Percentile Output:								
fB%	2.0		2.1		2.4	1.7	1.8	
BOQ	17.2		14.0		9.6	50.3	24.6	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	392						969			732		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.68	0.33	31.4	C	31.4	C

Westbound

Northbound

T 2134 3842 0.47 0.56 12.5 B 12.5 B

Southbound

T 1951 3512 0.41 0.56 12.1 B 12.1 B

Intersection Delay = 16.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	392						969			732		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	114						252			199		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	456						1009			796		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	392						969			732		
PHF	0.86						0.96			0.92		
Adj flow	456						1009			796		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	456						1009			796		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	0
fW	1.133						1.083			1.000		
fHV	0.980						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2006						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	456	2006	# 0.23	0.33	669	0.68
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1009	3842	# 0.26	0.56	2134	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	796	3512	0.23	0.56	1951	0.41
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.49$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.55$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.68	0.33	25.9	1.000	669	0.50	5.5	0.0	31.4	C	31.4	C	
Westbound													
Northbound													
T	0.47	0.56	12.1	1.000	2134	0.50	0.4	0.0	12.5	B	12.5	B	
Southbound													
T	0.41	0.56	11.5	1.000	1951	0.50	0.6	0.0	12.1	B	12.1	B	

Intersection delay = 16.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	25.9	0.00	0.0	0.0	31.4
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	12.1	0.00	0.0	0.0	12.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.5	0.00	0.0	0.0	12.1
	0.0						0.0	
Intersection Delay			16.2	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	456						529		418	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2017		1844	
LnCapacity	669						1120		1024	
Flow Ratio	0.2						0.3		0.2	
v/c Ratio	0.68						0.47		0.41	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.567		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	9.8						8.0		6.0	
kB	0.9						0.7		1.1	
Q2	1.7						0.6		0.8	
Q Average	11.6						8.6		6.8	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	14.0						10.5		8.3	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	16.5						12.5		10.0	
QSRatio										
90th Percentile Output:										
fB%	1.5						1.6		1.6	
BOQ	17.9						13.7		11.0	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	19.7						15.3		12.6	
QSRatio										
98th Percentile Output:										
fB%	1.8						2.0		2.1	
BOQ	21.4						16.9		14.1	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						732	
Peak-Hour Factor, PHF						0.92	
Hourly Flow Rate, HFR						795	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							57
Peak Hour Factor, PHF							0.88
Hourly Flow Rate, HFR							64
Percent Heavy Vehicles							5
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound	
	1	4	7	8	9	10	11
Lane Config							12
							R
v (vph)							64
C(m) (vph)							645
v/c							0.10
95% queue length							0.33
Control Delay							11.2
LOS							B
Approach Delay						11.2	
Approach LOS						B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					732	
Peak-Hour Factor, PHF					0.92	
Peak-15 Minute Volume					199	
Hourly Flow Rate, HFR					795	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						57
Peak Hour Factor, PHF						0.88
Peak-15 Minute Volume						16
Hourly Flow Rate, HFR						64
Percent Heavy Vehicles						5
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								398
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St. 9 12

Conflicting Flows 398
Potential Capacity 645
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity 645
Probability of Queue free St. 1.00 0.90

Step 2: LT from Major St. 4 1

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00
Maj L-Shared Prob Q free St.

Step 3: TH from Minor St. 8 11

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 0.90 1.00
Movement Capacity

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 8 11

Part 1 - First Stage

Conflicting Flows
Potential Capacity 900 402
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 900 402
Probability of Queue free St. 1.00 1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	402	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	402	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	448
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	448

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	683	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	1.00
Movement Capacity	615	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.90	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						64
Movement Capacity (vph)						645
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						645
Volume						64
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								64
C(m) (vph)								645
v/c								0.10
95% queue length								0.33
Control Delay								11.2
LOS								B
Approach Delay							11.2	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Volume	176	428	227	272	679	102	232	479	221	243	140	159
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	81	242	2.33	0.33	656.1	F		
TR	599	1798	1.09	0.33	87.7	F	215.4	F
Westbound								
L	83	240	3.41	0.34	1141	F		
TR	1188	3450	0.83	0.34	33.3	C	279.9	F
Northbound								
LTR	964	3469	1.07	0.28	83.7	F	83.7	F
Southbound								
L	384	1728	0.75	0.22	43.8	D		
TR	359	1616	0.99	0.22	76.8	E	62.0	E

Intersection Delay = 175.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	176	428	227	272	679	102	232	479	221	243	140	159
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	115	61	71	218	33	64	133	61	72	42	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	189	652		283	988			1036		289	356	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.249			0.000	
Prop RTs		0.294			0.118			0.237			0.531	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	176	428	227	272	679	102	232	479	221	243	140	159
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	189	460	192	283	871	117	258	532	246	289	167	189
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L TR			L TR			L TR			L TR		
Adj flow	189	652		283	988		1036			289	356	
Prop LTs	1.000	0.000		1.000	0.000		0.249			0.000		
Prop RTs	0.294			0.118			0.237			0.531		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.956			0.982		0.964				0.920	
fLT	0.133	1.000		0.129	1.000		0.988			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	242	1798		240	3450		3469			1728	1616	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	189	242	0.78	0.33	81	2.33
Prot							
Perm							
Thru	TR	652	1798	0.36	0.33	599	1.09
Right							
Westbound							
Prot							
Perm							
Left	L	283	240	# 1.18	0.34	83	3.41
Prot							
Perm							
Thru	TR	988	3450	0.29	0.34	1188	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1036	3469	# 0.30	0.28	964	1.07
Right							
Southbound							
Prot							
Perm							
Left	L	289	1728	0.17	0.22	384	0.75
Prot							
Perm							
Thru	TR	356	1616	# 0.22	0.22	359	0.99
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.70$
Total lost time per cycle, $L = 14.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 2.01$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	2.33	0.33	30.0	1.000	81	0.50	626.1	0.0	656.1	F		
TR	1.09	0.33	30.0	1.000	599	0.50	57.7	0.0	87.7	F	215.4	F
Westbound												
L	3.41	0.34	29.5	1.000	83	0.50	1111	0.0	1141	F		
TR	0.83	0.34	27.1	1.000	1188	0.50	6.2	0.0	33.3	C	279.9	F
Northbound												
LTR	1.07	0.28	32.5	1.000	964	0.50	51.2	0.0	83.7	F	83.7	F
Southbound												
L	0.75	0.22	32.7	1.000	384	0.50	11.1	0.0	43.8	D		
TR	0.99	0.22	34.9	1.000	359	0.50	41.9	0.0	76.8	E	62.0	E

Intersection delay = 175.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	189	283		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	988	652		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.72	7.08		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.97	16.30		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	18.90	30.08		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.10	0.92		
n=Max(gq-gf)/2,0)	9.45	15.04		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.44	2.40		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.13	0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.133	0.129		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.249 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	18.90			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.630			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	988			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.118
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	27.0	0.0	656.1
TR	0.0	0.00	30.0	30.0	0.00	13.3	0.0	87.7
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	50.0	0.0	1141
TR	0.0	0.00	29.5	27.1	0.00	0.0	0.0	33.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	32.5	0.00	18.0	0.0	83.7
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.7	0.00	0.0	0.0	43.8
TR	0.0	0.00	35.0	34.9	0.00	0.0	0.0	76.8
	0.0						0.0	

Intersection Delay	175.0	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	189	652		283	518		544			289	356	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	242	1798		240	1811		1821			1728	1616	
LnCapacity	81	599		83	623		506			384	359	
Flow Ratio	0.8	0.4		1.2	0.3		0.3			0.2	0.2	
v/c Ratio	2.33	1.09		3.41	0.83		1.08			0.75	0.99	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.7	16.3		7.1	11.9		13.6			6.7	8.9	
kB	0.1	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	13.7	10.8		25.3	3.0		9.7			1.4	4.4	
Q Average	18.5	27.1		32.3	14.9		23.3			8.1	13.3	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	22.2	32.6		38.8	17.9		28.0			9.9	16.1	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.4			1.5	1.4	
BOQ	26.0	38.0		45.3	21.1		32.7			11.8	18.9	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.5	1.5		1.5			1.6	1.5	
BOQ	27.9	40.8		48.5	22.7		35.1			13.0	20.4	
QSRatio												
95th Percentile Output:												
fB%	1.6	1.6		1.6	1.7		1.6			1.8	1.7	
BOQ	30.0	43.5		51.8	24.6		37.5			14.6	22.2	
QSRatio												
98th Percentile Output:												
fB%	1.7	1.7		1.7	1.8		1.7			2.0	1.8	
BOQ	32.1	46.3		55.0	26.4		40.0			16.2	24.0	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								637	
Peak-Hour Factor, PHF								0.93	
Hourly Flow Rate, HFR								684	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided				/			
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		178							
Peak Hour Factor, PHF		0.90							
Hourly Flow Rate, HFR		197							
Percent Heavy Vehicles		1							
Percent Grade (%)		0						0	
Flared Approach: Exists?/Storage								/	/
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			197						
C(m) (vph)			416						
v/c			0.47						
95% queue length			2.47						
Control Delay			21.2						
LOS			C						
Approach Delay				21.2					
Approach LOS				C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 637
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 171
 Hourly Flow Rate, HFR 684
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 49
 Hourly Flow Rate, HFR 197
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			684					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	684	
Potential Capacity	416	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	416	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 684
Potential Capacity 416
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 416

Results for Two-stage process:
a
y
C t 416

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	197					
Movement Capacity (vph)	416					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	416					
Volume	197					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			197					
C(m) (vph)			416					
v/c			0.47					
95% queue length			2.47					
Control Delay			21.2					
LOS			C					
Approach Delay				21.2				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.6

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	21	264	59	110	268	245	61	59	94	111	269	83
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.85	0.85	0.96	0.99	0.89	0.89	0.92	0.92
Flow Rate	179	224	253	382	134	105	265	236
% Heavy Veh	0	0	0	1	1	1	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	179	224	253	382	134	105	265	236
Left-Turn	24	0	114	0	68	0	120	0
Right-Turn	0	69	0	247	0	105	0	90
Prop. Left-Turns	0.1	0.0	0.5	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.3	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.1	-0.2	0.2	-0.4	0.3	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	179	224	253	382	134	105	265	236
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.16	0.20	0.22	0.34	0.12	0.09	0.24	0.21
hd, final value	8.07	7.79	7.88	7.22	8.70	7.75	8.13	7.64
x, final value	0.40	0.48	0.55	0.77	0.32	0.23	0.60	0.50
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.8	5.5	5.6	4.9	6.4	5.4	5.8	5.3

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	179	224	253	382	134	105	265	236
Service Time	5.8	5.5	5.6	4.9	6.4	5.4	5.8	5.3
Utilization, x	0.40	0.48	0.55	0.77	0.32	0.23	0.60	0.50
Dep. headway, hd	8.07	7.79	7.88	7.22	8.70	7.75	8.13	7.64
Capacity	429	449	450	493	384	355	434	460
Delay	16.07	17.59	19.93	29.82	15.51	12.70	22.25	17.76
LOS	C	C	C	D	C	B	C	C
Approach:								
Delay	16.92		25.88		14.28		20.13	
LOS	C		D		B		C	
Intersection Delay	20.67				Intersection LOS C			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	81	162	609	235	552	25	345	268	115	26	831	167
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 805 3151 1.15 0.26 113.2 F 113.2 F

Westbound

LTR 898 3514 1.16 0.26 116.1 F 116.1 F

Northbound

DefL 93 289 3.95 0.32 1382 F
 TR 598 1857 0.70 0.32 33.5 C 661.5 F

Southbound

LTR 974 3024 1.13 0.32 102.7 F 102.7 F

Intersection Delay = 223.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81	162	609	235	552	25	345	268	115	26	831	167
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	22	44	165	75	177	8	92	74	32	7	223	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		926			1041		367	421			1102	
%InSharedLn												
Prop LTs		0.095			0.289		1.000	0.000			0.025	
Prop RTs		0.715			0.031			0.299			0.163	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81	162	609	235	552	25	345	268	115	26	831	167
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	88	176	662	301	708	32	367	295	126	28	894	180
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	926			1041			367 421			1102		
Prop LTs	0.095			0.289			1.000 0.000			0.025		
Prop RTs	0.715			0.031			0.299			0.163		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.893			0.995			0.955			0.975		
fLT	0.995			0.986			0.138 1.000			0.935		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3151			3514			289 1857			3024		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	926	3151	# 0.29	0.26	805	1.15
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1041	3514	# 0.30	0.26	898	1.16
Right							
Northbound							
Prot							
Perm							
Left	DefL	367	289	# 1.27	0.32	93	3.95
Prot							
Perm							
Thru	TR	421	1857	0.23	0.32	598	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1102	3024	0.36	0.32	974	1.13
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.86
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.23

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	1.15	0.26	33.5	1.000	805	0.50	79.7	0.0	113.2	F	113.2	F
Westbound												
LTR	1.16	0.26	33.5	1.000	898	0.50	82.6	0.0	116.1	F	116.1	F
Northbound												
DefL	3.95	0.32	30.5	1.000	93	0.50	1351	0.0	1382	F		
TR	0.70	0.32	26.7	1.000	598	0.50	6.8	0.0	33.5	C	661.5	F
Southbound												
LTR	1.13	0.32	30.5	1.000	974	0.50	72.2	0.0	102.7	F	102.7	F

Intersection delay = 223.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			367	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			1102	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			9.18	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			14.47	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			23.91	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.09	
n=Max(gq-gf)/2,0)			11.96	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.85	
EL2=Max((1-Ptho*n)/Plto, 1.0)			10.42	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			23.91	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.14	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.138	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	28
Proportion of LT in LT lane group, PLT	0.095 0.289 0.000 0.025
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	421
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.70
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.26
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	3.08
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.35
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06
EL1 (refer to Exhibit C16-3)	2.13
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				3.08
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.106
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				421
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.025
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.715	0.031	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	30.2	0.0	113.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	35.7	0.0	116.1
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	68.5	0.0	1382
TR	0.0	0.00	30.5	26.7	0.00	0.0	0.0	33.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.5	0.00	32.0	0.0	102.7
	0.0						0.0	
Intersection Delay			223.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	486		546		367	421	578	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0	0 2 0	0 0
SL	1654		1845		289	1857	1588	
LnCapacity	422		471		93	598	511	
Flow Ratio	0.3		0.3		1.3	0.2	0.4	
v/c Ratio	1.15		1.16		3.95	0.70	1.13	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	12.1		13.6		9.2	9.2	14.4	
kB	0.5		0.6		0.2	0.8	0.7	
Q2	10.9		12.5		34.5	1.8	12.5	
Q Average	23.0		26.2		43.7	11.0	27.0	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	27.7		31.5		52.5	13.3	32.4	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.4	1.4	
BOQ	32.3		36.7		61.2	15.7	37.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.5	
BOQ	34.7		39.4		65.6	17.1	40.5	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.6		1.6	1.7	1.6	
BOQ	37.1		42.1		69.9	18.8	43.2	
QSRatio								
98th Percentile Output:								
fB%	1.7		1.7		1.7	1.9	1.7	
BOQ	39.5		44.7		74.3	20.5	46.0	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 6/19/13	Jurisd: Sat Flw Rate EB-L = 2100
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	877	484			517	1150				241		215
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left	P	
	Thru		P				Thru		
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

[illegible]

L	895	1909	1.01	0.72	45.3	D		
T	1170	1646	0.43	0.71	6.0	A	31.3	C

T	460	1881	1.20	0.24	126.1	F	689.1	F
R	391	1599	3.03	0.24	950.2	F		

L	576	3239	0.45	0.18	35.7	D	22.3	C
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Intersection Delay = 343.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	877	484			517	1150				241		215
% Heavy Veh	1	1			1	1				1		1
PHF	0.97	0.96			0.94	0.97				0.92		0.92
PK 15 Vol	226	126			138	296				65		58
Hi Ln Vol												
% Grade		0			0					0		
Ideal Sat	2100	1900			1900	1900				1900		1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0
Adj Flow	904	504			550	1186				262		234
%InSharedLn												
Prop LTs	1.000	0.000			0.000							
Prop RTs		0.000			0.000	1.000						1.000
Peds Bikes					0		0			0		
Buses	0	0			0	0				0		0
%InProtPhase	50.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0				0.0		0.0
Arriv. Type	3	3			3	3				3		3
Unit Ext.	3.0	3.0			3.0	3.0				3.0		3.0
I Factor		0.508			0.176					1.000		
Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Ext of g	3.0	2.0			2.0	2.0				2.0		2.0
Ped Min g					24.6		3.2			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	877	484			517	1150							241		215
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	904	504			550	1186							262		234
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T	R		L	T	R
Adj flow	904	504			550	1186			262				234		
Prop LTs	1.000	0.000			0.000										
Prop RTs		0.000			0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T	R		L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0	2	0	1			
fW	0.967	1.000			1.000	1.000				0.933		0.933			
fHV	0.990	0.990			0.990	0.990				0.990		0.990			
fG	1.000	1.000			1.000*1.000*					1.000		1.000			
fP	1.000	0.875			1.000	1.000				1.000		1.000			
fBB	1.000	1.000			1.000	1.000				1.000		1.000			
fA	1.000	1.000			1.000	1.000				1.000		1.000			
fLU	1.000	1.000			1.000	1.000				0.971		1.000			
fRT		1.000			1.000	0.850						0.850			
fLT	0.950	1.000			1.000					0.950					
Sec.	0.148														
fLpb	1.000	1.000			1.000					1.000					
fRpb		1.000			1.000	1.000								1.000	
S	1909	1646			1881	1599				3239				1492	
Sec.	298														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

R 0.24 0.64 6.7 1.000 962 0.50 0.6 0.0 7.3 A

Intersection delay = 343.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			
Effective permitted green time for LT lane group, g(s)	27.0			
Opposing effective green time, go (s)	22.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	904			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	550			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLT/C	22.60			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.75			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			
gq, (see Exhibit C16-4,5,6,7,8)	27.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.00			
n=Max(gq-gf)/2,0)	13.50			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.18			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	904			
v/c ratio from Capacity Worksheet, X	1.01			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	23.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	25.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.25			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.56			
XPerm	3.00			
XProt	0.78			
Case	3			
Queue at beginning of green arrow, Qa	10.69			
Queue at beginning of unsaturated green, Qu	5.72			
Residual queue, Qr	4.48			
Uniform Delay, d1	21.4			

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.4	0.00	2.3	0.0	45.3
T	0.0	0.00	13.0	5.4	0.00	0.0	0.0	6.0
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	34.0	34.0	0.00	22.5	0.0	126.1
R	0.0	0.00	34.0	34.0	0.00	198.8	0.0	950.2
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.1	0.00	0.0	0.0	35.7
	0.0						0.0	
R	0.0	0.00	16.0	6.7	0.00	0.0	0.0	7.3
Intersection Delay			343.8	sec/veh	Intersection LOS F			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	904	504		550	1186				134	234
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1240	1646		1881	1599				1668	1492
LnCapacity	895	1170		460	391				296	962
Flow Ratio	0.7	0.3		0.3	0.7				0.1	0.2
v/c Ratio	1.01	0.43		1.20	3.03				0.45	0.24
Grn Ratio	0.72	0.71		0.24	0.24				0.18	0.64
I Factor		0.508		0.176						1.000
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00	1.00				1.00	1.00
Q1	10.9	5.2		13.8	29.6				3.0	2.5
kB	0.5	0.6		0.1	0.1				0.5	1.1
Q2	8.4	0.5		11.9	99.5				0.4	0.4
Q Average	19.2	5.7		25.7	129.2				3.4	2.8
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2				1.3	1.3
BOQ	23.1	7.1		30.8	155				4.2	3.5
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4				1.6	1.6
BOQ	27.1	8.6		36.0	181				5.3	4.4
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5				1.8	1.8
BOQ	29.1	9.5		38.6	194				5.9	5.0
QSRatio										
95th Percentile Output:										
fB%	1.6	1.9		1.6	1.6				2.1	2.2
BOQ	31.2	11.0		41.2	207				7.1	6.1
QSRatio										
98th Percentile Output:										
fB%	1.7	2.2		1.7	1.7				2.5	2.6
BOQ	33.3	12.5		43.9	220				8.3	7.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 6/19/13	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 With-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	736	1471	0.96	0.50	46.8	D		
TR	1066	2132	0.05	0.50	11.6	B	44.6	D

LTR	1633	3266	0.06	0.50	11.7	B	11.7	B
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	544	1399	0.17	0.39	18.5	B	501.2	F
R	622	1599	2.12	0.39	534.2	F		

Intersection Delay = 326.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	178	12	0	0	13	16	0	0	1	23	0	436
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	710	48			99			1			90	1316
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0		0	0	
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.967		1.000			1.000			0.855		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3		17.5			20.3			20.3		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	682	46	0	0	46	58	0	0	1	84	0	1622
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	710	48	0	0	51	48	0	0	1	90	0	1316
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	710	48			99			1			90	1316
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.690	1.000		1.000			1.000			0.744	
Sec.											
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	1471	2132		3266			3045			1399	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	710	1471	# 0.48	0.50	736	0.96
Prot							
Perm							
Thru	TR	48	2132	0.02	0.50	1066	0.05
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	99	3266	0.03	0.50	1633	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	90	1399	0.06	0.39	544	0.17
Right	R	1316	1599	# 0.82	0.39	622	2.12

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.31
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.47

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.96	0.50	21.7	1.000	736	0.50	25.1	0.0	46.8	D			
TR	0.05	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	44.6	D	
Westbound													
LTR	0.06	0.50	11.6	1.000	1633	0.50	0.1	0.0	11.7	B	11.7	B	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.17	0.39	18.0	1.000	544	0.50	0.6	0.0	18.5	B	501.2	F	

R 2.12 0.39 27.5 1.000 622 0.50 506.7 0.0 534.2 F

Intersection delay = 326.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	710			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	99			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	17.75			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.30			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.45			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.690			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	90
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	48	90	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.25
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.60	2.25	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.77
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.744

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	99	48	90	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.485	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	21.7	0.00	0.0	0.0	46.8
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	18.0	0.00	0.0	0.0	18.5
R	0.0	0.00	27.5	27.5	0.00	173.5	0.0	534.2
Intersection Delay			326.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	710	48			51				0				90	1316	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1471	2132			1715				1599				1399	1599	
LnCapacity	736	1066			857				621				544	622	
Flow Ratio	0.5	0.0			0.0				0.0				0.1	0.8	
v/c Ratio	0.96	0.05			0.06				0.00				0.17	2.12	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	17.1	0.6			0.7				0.0				1.5	32.9	
kB	0.9	1.2			1.0				0.8				0.6	0.7	
Q2	7.4	0.1			0.1				0.0				0.1	88.1	
Q Average	24.6	0.7			0.7				0.0				1.6	121.0	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	29.5	0.9			0.9				0.0				2.0	145	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	34.4	1.1			1.2				0.0				2.6	169	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	36.9	1.3			1.4				0.0				3.0	181	
QSRatio															
95th Percentile Output:															
fB%	1.6	2.5			2.5				2.6				2.3	1.6	
BOQ	39.5	1.7			1.8				0.0				3.7	194	
QSRatio															
98th Percentile Output:															
fB%	1.7	3.0			3.0				3.2				2.8	1.7	
BOQ	42.0	2.0			2.2				0.0				4.5	206	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	434		35				5	297			777	907
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.89	0.32	36.6	D	35.4	D
R	497	1568	0.06	0.32	14.5	B		
Westbound								

Northbound

LT 1455 2817 0.24 0.52 8.4 A 8.4 A

Southbound

TR 1928 3731 0.98 0.52 24.8 C 24.8 C

Intersection Delay = 24.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	434		35				5	297		777	907	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	128		10				2	84		218	255	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	511		31					344			1892	
%InSharedLn												
Prop LTs								0.017			0.000	
Prop RTs			1.000					0.000			0.539	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	434		35				5	297		777	907	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	511		31				6	338		873	1019	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	511		31					344			1892	
Prop LTs								0.017			0.000	
Prop RTs			1.000					0.000			0.539	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.971	0.971			0.990		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.919	
fLT	0.950				0.800		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1811	1568			2817		3731	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	511	1811	# 0.28	0.32	573	0.89
Prot							
Perm							
Thru							
Right	R	31	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	344	2817	0.12	0.52	1455	0.24
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1892	3731	# 0.51	0.52	1928	0.98
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.79
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.95

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.89	0.32	19.5	1.000	573	0.50	17.1	0.0	36.6	D	35.4	D	
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B			
Westbound													
Northbound													
LT	0.24	0.52	8.0	1.000	1455	0.50	0.4	0.0	8.4	A	8.4	A	
Southbound													
TR	0.98	0.52	14.2	1.000	1928	0.50	10.6	0.0	24.8	C	24.8	C	

Intersection delay = 24.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+Pl)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.017 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1892
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	16.56
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	30.74
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.26
n=Max(gq-gf)/2,0)	4.78
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	9.51
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.800

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			30.74	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.992	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1892	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.017	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.539
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	19.5	0.00	0.0	0.0	36.6
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	8.0	0.00	0.0	0.0	8.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	14.2	0.00	0.0	0.0	24.8
	0.0						0.0	
Intersection Delay			24.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	511	31				180		993	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1479		1959	
LnCapacity	573	497				764		1012	
Flow Ratio	0.3	0.0				0.1		0.5	
v/c Ratio	0.89	0.06				0.24		0.98	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	8.1	0.4				1.7		16.2	
kB	0.5	0.5				0.7		0.4	
Q2	3.1	0.0				0.2		6.1	
Q Average	11.2	0.4				1.9		22.4	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	13.5	0.5				2.4		26.9	
QSRatio									
85th Percentile Output:									
fB%	1.4	1.7				1.6		1.4	
BOQ	16.0	0.7				3.0		31.4	
QSRatio									
90th Percentile Output:									
fB%	1.6	2.0				1.8		1.5	
BOQ	17.4	0.8				3.4		33.7	
QSRatio									
95th Percentile Output:									
fB%	1.7	2.5				2.3		1.6	
BOQ	19.1	1.0				4.3		36.1	
QSRatio									
98th Percentile Output:									
fB%	1.9	3.1				2.7		1.7	
BOQ	20.8	1.2				5.1		38.4	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	65	0		725	89		5			28	959	45
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR 784 1881 0.11 0.42 11.0 B 11.0 B

Westbound

L 562 1348 1.42 0.42 215.7 F
 T 802 1925 0.12 0.42 11.1 B 193.3 F

Northbound

L 120 289 0.05 0.42 11.2 B
 11.2 B

Southbound

LTR 2027 4866 0.57 0.42 14.6 B 14.6 B

Intersection Delay = 88.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		65	0	725	89		5			28	959	45
% Heavy Veh		1	1	2	2		0			2	2	2
PHF		0.75	0.25	0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol		22	0	199	24		2			8	269	13
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		87		797	98		6				1160	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.027	
Prop RTs		0.000			0.000						0.044	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.971			0.951		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65	0		725	89		5			28	959	45
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	87	0		797	98		6			31	1078	51
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	87			797	98		6			1160		
Prop LTs	0.000			1.000 0.000			1.000			0.027		
Prop RTs	0.000			0.000						0.044		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.993	
fLT	1.000		0.701 1.000		0.163		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1348 1925		289		4866	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	87	1881	0.05	0.42	784	0.11
Right							
Westbound							
Prot							
Perm							
Left	L	797	1348	# 0.59	0.42	562	1.42
Prot							
Perm							
Thru	T	98	1925	0.05	0.42	802	0.12
Right							
Northbound							
Prot							
Perm							
Left	L	6	289	0.02	0.42	120	0.05
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1160	4866	# 0.24	0.42	2027	0.57
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.83
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.00

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.11	0.42	10.7	1.000	784	0.50	0.3	0.0	11.0	B	11.0	B	
Westbound													
L	1.42	0.42	17.5	1.000	562	0.50	198.2	0.0	215.7	F			
T	0.12	0.42	10.8	1.000	802	0.50	0.3	0.0	11.1	B	193.3	F	
Northbound													
L	0.05	0.42	10.4	1.000	120	0.50	0.7	0.0	11.2	B			
											11.2	B	
Southbound													
LTR	0.57	0.42	13.4	1.000	2027	0.50	1.2	0.0	14.6	B	14.6	B	

Intersection delay = 88.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		797	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		87	1160	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		13.28	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.45	7.10	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	7.42	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	17.58	
n=Max(gq-gf)/2,0)		0.00	3.71	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.43	4.32	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.58	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	7.42	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.70	0.16	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.701	0.163	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT 0.000 0.000 0.027
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo 1.000 1.000 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
or $flt = [fm + 0.91(N - 1)] / N^*$
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	T	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	87		797	98	6			425	
So	1900		1900	1900	1900			1900	
No.Lanes	0 1 0		1 1 0		1 0 0			0 3 0	
SL	1881		1348	1925	289			1786	
LnCapacity	784		562	802	120			744	
Flow Ratio	0.0		0.6	0.1	0.0			0.2	
v/c Ratio	0.11		1.42	0.12	0.05			0.57	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000			0.971		0.951		1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.9		13.3	1.0	0.1			5.4	
kB	0.7		0.6	0.7	0.2			0.7	
Q2	0.1		31.2	0.1	0.0			0.9	
Q Average	1.0		44.4	1.1	0.1			6.3	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3			1.2	
BOQ	1.3		53.3	1.4	0.1			7.8	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.4	1.6	1.7			1.5	
BOQ	1.6		62.2	1.8	0.1			9.4	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.5	1.9	2.0			1.6	
BOQ	1.9		66.7	2.1	0.1			10.4	
QSRatio									
95th Percentile Output:									
fB%	2.4		1.6	2.4	2.6			1.9	
BOQ	2.4		71.1	2.7	0.2			11.9	
QSRatio									
98th Percentile Output:									
fB%	2.9		1.7	2.9	3.2			2.1	
BOQ	2.9		75.6	3.2	0.2			13.4	
QSRatio									

ERROR MESSAGES

No errors to report.

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Englewood Ave & Vets Rd W RT
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Englewood Avenue
North/South Street: Veterans Rd W Right Turn Bay
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R
Volume			65				
Peak-Hour Factor, PHF			0.75				
Hourly Flow Rate, HFR			86				
Percent Heavy Vehicles			--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes			1				
Configuration			T				
Upstream Signal?			No			No	

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			726			
Peak Hour Factor, PHF			0.88			
Hourly Flow Rate, HFR			825			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Lanes	Exists?	Storage		/		/
Configuration			1 R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					825			
C(m) (vph)					978			
v/c					0.84			
95% queue length					10.46			
Control Delay					24.8			
LOS					C			
Approach Delay				24.8				
Approach LOS				C				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 65
 Peak-Hour Factor, PHF 0.75
 Peak-15 Minute Volume 22
 Hourly Flow Rate, HFR 86
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 726
 Peak Hour Factor, PHF 0.88
 Peak-15 Minute Volume 206
 Hourly Flow Rate, HFR 825
 Percent Heavy Vehicles 0
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					86			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	86	
Potential Capacity	978	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	978	
Probability of Queue free St.	0.16	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.16
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.16
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			825			
Movement Capacity (vph)			978			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			978			
Volume			825			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					825			
C(m) (vph)					978			
v/c					0.84			
95% queue length					10.46			
Control Delay					24.8			
LOS					C			
Approach Delay				24.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	77	35	379	60	0	0	0	0	17	129	13
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.75		0.85				0.89 0.89	
Flow Rate	148		515				90 87	
% Heavy Veh	2		4				0 0	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	148		515				90	87
Left-Turn	0		445				19	0
Right-Turn	46		0				0	14
Prop. Left-Turns	0.0		0.9				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.2
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 6/19/13
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Conditions
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	26	68	0	0	385	24	53	106	138	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	124		480		110		200	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	124		480		110	200		
Left-Turn	34		0		55	0		
Right-Turn	0		28		0	145		
Prop. Left-Turns	0.3		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	-0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	124		480		110	200		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.11		0.43		0.10	0.18		
hd, final value	5.41		4.85		5.54	5.00		
x, final value	0.19		0.65		0.17	0.28		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.4		2.9		3.5	3.0		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	124		480		110	200		
Service Time	3.4		2.9		3.5	3.0		
Utilization, x	0.19		0.65		0.17	0.28		
Dep. headway, hd	5.41		4.85		5.54	5.00		
Capacity	374		727		360	450		
Delay	9.65		16.29		9.67	9.92		
LOS	A		C		A	A		
Approach:								
Delay		9.65		16.29		9.83		
LOS		A		C		A		
Intersection Delay	13.20							

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	217	390	213	0	87	15	726	65	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	555	1585	1.46	0.35	235.3	F	192.5	F
R	560	1599	0.35	0.35	16.2	B		

Westbound

LTR	561	1602	0.22	0.35	14.6	B	14.6	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2266	4688	0.38	0.48	10.3	B	10.3	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 103.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	217	390	213	0	87	15	726	65	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	72	130	71	0	26	5	195	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		809	196		123			854				
%InSharedLn												
Prop LTs		0.357			0.000			0.915				
Prop RTs		0.000	1.000		0.146			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	217	390	213	0	87	15	726	65	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	289	520	196	0	105	18	781	70	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT		R	LTR			LTR					
Adj flow	809		196	123			854					
Prop LTs	0.357			0.000			0.915					
Prop RTs	0.000		1.000	0.146			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		1.000			0.980				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.980			0.999				
fLT	0.815			1.000			0.956				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1585	1599		1602			4688				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.46	0.35	19.5	1.000	555	0.50	215.8	0.0	235.3	F	192.5	F
R	0.35	0.35	14.4	1.000	560	0.50	1.7	0.0	16.2	B		
Westbound												
LTR	0.22	0.35	13.7	1.000	561	0.50	0.9	0.0	14.6	B	14.6	B
Northbound												
LTR	0.38	0.48	9.8	1.000	2266	0.50	0.5	0.0	10.3	B	10.3	B
Southbound												

Intersection delay = 103.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	289	0	
Proportion of LT in LT lane group, PLT	0.357	0.000	0.915
Proportion of LT in opposing flow, PLTo	0.00	0.36	
Adjusted opposing flow rate, Vo (veh/h)	123	809	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.82	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.05	13.48	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.41	17.72	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.59	3.28	
n=Max(gq-gf)/2,0)	0.20	8.86	
PTHo=1-PLTo	1.00	0.64	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.36	0.00	
EL1 (refer to Exhibit C16-3)	1.57	3.11	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.74	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	17.72	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.16	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.815	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.41	17.72		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.019	0.844		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	123	809	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.357	0.000	0.915	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.146	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	63.5	0.0	235.3
R	0.0	0.00	19.5	14.4	0.00	0.0	0.0	16.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.7	0.00	0.0	0.0	14.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.8	0.00	0.0	0.0	10.3
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			103.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	809	196	123	313			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1585	1599	1602	1720			
LnCapacity	555	560	561	831			
Flow Ratio	0.5	0.1	0.1	0.2			
v/c Ratio	1.46	0.35	0.22	0.38			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.997		0.993	0.967			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	13.5	2.4	1.4	3.3			
kB	0.6	0.6	0.6	0.7			
Q2	33.5	0.3	0.2	0.4			
Q Average	46.9	2.7	1.6	3.7			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.2			
BOQ	56.3	3.4	2.0	4.7			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.5			
BOQ	65.7	4.3	2.6	5.8			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.8	1.9	1.7			
BOQ	70.4	4.9	3.0	6.5			
QSRatio							
95th Percentile Output:							
fB%	1.6	2.2	2.3	2.1			
BOQ	75.1	5.9	3.7	7.7			
QSRatio							
98th Percentile Output:							
fB%	1.7	2.6	2.8	2.4			
BOQ	79.8	7.0	4.5	9.0			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	337		56				17	402		382	85	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 468 1754 0.91 0.27 44.8 D 44.8 D

Westbound

Northbound

LT 1110 1959 0.41 0.57 8.4 A 8.4 A

Southbound

TR 1179 2080 0.44 0.57 8.6 A 8.6 A

Intersection Delay = 19.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	337		56				17	402		382	85	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
PK 15 Vol	92		15				5	109		105	23	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		427						455			513	
%InSharedLn												
Prop LTs		0.857						0.040			0.000	
Prop RTs		0.143						0.000			0.181	
Peds Bikes	0			0						0		0
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.937						0.937			0.937	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	337		56				17	402		382	85	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
Adj flow	366		61				18	437		420	93	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		427						455			513	
Prop LTs		0.857						0.040			0.000	
Prop RTs	0.143						0.000			0.181		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.981						1.000			0.976		
fLT	0.959						0.976			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1754						1959			2080		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	427	1754	# 0.24	0.27	468	0.91
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	455	1959	0.23	0.57	1110	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	513	2080	# 0.25	0.57	1179	0.44
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.49

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.59

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.91	0.27	21.3	1.000	468	0.50	23.5	0.0	44.8	D	44.8	D
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1110	0.50	1.1	0.0	8.4	A	8.4	A
Southbound												
TR	0.44	0.57	7.5	1.000	1179	0.50	1.1	0.0	8.6	A	8.6	A

Intersection delay = 19.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	18
Proportion of LT in LT lane group, PLT	0.857
Proportion of LT in opposing flow, PLTo	0.040 0.000
Adjusted opposing flow rate, Vo (veh/h)	513
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.30
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.43
gq, (see Exhibit C16-4,5,6,7,8)	5.44
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04
EL1 (refer to Exhibit C16-3)	2.33
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.976

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.44	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.160	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			513	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.040	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.181
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	21.3	0.00	0.0	0.0 0.0 0.0	44.8
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	7.3	0.00	0.0	0.0 0.0 0.0	8.4
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	7.5	0.00	0.0	0.0 0.0 0.0	8.6
Intersection Delay			19.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	427						455			513		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1754						1959			2080		
LnCapacity	468						1110			1179		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.91						0.41			0.44		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.937						0.937			0.937		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	6.9						4.3			4.9		
kB	0.5						0.9			0.9		
Q2	3.1						0.6			0.7		
Q Average	10.0						4.9			5.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	12.1						6.0			6.9		
QSRatio												
85th Percentile Output:												
fB%	1.4						1.5			1.5		
BOQ	14.4						7.4			8.4		
QSRatio												
90th Percentile Output:												
fB%	1.6						1.7			1.7		
BOQ	15.6						8.2			9.3		
QSRatio												
95th Percentile Output:												
fB%	1.7						2.0			1.9		
BOQ	17.3						9.6			10.8		
QSRatio												
98th Percentile Output:												
fB%	1.9						2.3			2.2		
BOQ	19.0						11.1			12.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrots Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrots Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	141		66				43	633		410	366	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								20	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 575 1726 0.48 0.33 18.5 B 18.5 B

Westbound

Northbound

LT 767 1534 0.96 0.50 35.8 D 35.8 D

Southbound

TR 1000 2000 0.83 0.50 20.1 C 20.1 C

Intersection Delay = 26.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	141		66				43	633		410	366	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	47		22				12	172		113	101	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		276						735			831	
%InSharedLn												
Prop LTs		0.681						0.064			0.000	
Prop RTs		0.319						0.000			0.457	
Peds Bikes	0	0		0						0	0	
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	141		66				43	633		410	366	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	188		88				47	688		451	380	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		276						735			831	
Prop LTs		0.681						0.064			0.000	
Prop RTs		0.319						0.000			0.457	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.957						1.000			0.938		
fLT	0.967						0.822			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1726						1534			2000		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	276	1726	# 0.16	0.33	575	0.48
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	735	1534	# 0.48	0.50	767	0.96
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	831	2000	0.42	0.50	1000	0.83
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.48	0.33	15.9	1.000	575	0.50	2.7	0.0	18.5	B	18.5	B
Westbound												
Northbound												
LT	0.96	0.50	14.4	1.000	767	0.50	21.4	0.0	35.8	D	35.8	D
Southbound												
TR	0.83	0.50	12.8	1.000	1000	0.50	7.3	0.0	20.1	C	20.1	C

Intersection delay = 26.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000
----------------------------------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

$gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

$gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$

$n = \text{Max}(gq - gf) / 2, 0$

PTHo=1-PLTo

$PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$

EL1 (refer to Exhibit C16-3)

$EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$

$fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$

$gdifff = \text{max}(gq - gf, 0)$

$fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)

$flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)

or $flt = [fm + 0.91(N-1)] / N^{**}$

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		47	
Proportion of LT in LT lane group, PLT	0.681	0.064	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		831	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.78	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.85	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		12.55	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.45	
n=Max(gq-gf)/2,0)		1.60	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.06	
EL1 (refer to Exhibit C16-3)		3.17	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.82	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.822	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			12.55	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.418	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		831	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.681		0.064	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.319	0.457
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	15.9	0.00	0.0	0.0	18.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	14.4	0.00	0.0	0.0	35.8
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	12.8	0.00	0.0	0.0	20.1
	0.0						0.0	
Intersection Delay			26.2	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	276						735			831		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1726						1534			2000		
LnCapacity	575						767			1000		
Flow Ratio	0.2						0.5			0.4		
v/c Ratio	0.48						0.96			0.83		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.7						11.8			11.8		
kB	0.5						0.6			0.8		
Q2	0.5						5.7			3.3		
Q Average	4.1						17.5			15.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.2						21.0			18.3		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.3						24.6			21.4		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.5			1.5		
BOQ	7.1						26.5			23.1		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.6			1.6		
BOQ	8.4						28.5			25.0		
QSRatio												
98th Percentile Output:												
fB%	2.4						1.7			1.8		
BOQ	9.8						30.5			26.9		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		193	301	625	173	152	228		420		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.12	0.13	23.7	C	145.2	F
R	220	1652	1.24	0.13	157.2	F		
Westbound								
LTR	1338	4724	0.94	0.28	29.3	C	29.3	C
Northbound								
L	139	416	1.19	0.33	152.2	F		
T	621	1863	0.40	0.33	17.1	B	71.1	E
Southbound								
TR	707	2121	0.69	0.33	21.4	C	21.4	C

Intersection Delay = 48.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		193	301	625	173	152	228		420	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		68	86	180	50	41	62		117	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		272		1263		165	248			486	
%InSharedLn												
Prop LTs					0.274		1.000	0.000			0.000	
Prop RTs			1.000		0.158			0.000		0.039		
Peds Bikes	0			0	0					0	0	
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		193	301	625	173	152	228		420	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		272	346	718	199	165	248		467	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	27		272		1263		165	248			486	
Prop LTs					0.274		1.000	0.000			0.000	
Prop RTs			1.000		0.158			0.000			0.039	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.980	0.980	0.990	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.976	0.976		1.000	0.995	0.995
fLT	0.950		0.986	0.986	0.223	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4724	4724	416	1863	2121	2121
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.13	222	0.12
Prot							
Perm							
Thru							
Right	R	272	1652	# 0.16	0.13	220	1.24
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1263	4724	# 0.27	0.28	1338	0.94
Right							
Northbound							
Prot							
Perm							
Left	L	165	416	# 0.40	0.33	139	1.19
Prot							
Perm							
Thru	T	248	1863	0.13	0.33	621	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	486	2121	0.23	0.33	707	0.69
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.83
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.10

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
L	0.12	0.13	22.9	1.000	222	0.50	0.8	0.0	23.7	C	145.2	F
R	1.24	0.13	26.0	1.000	220	0.50	131.2	0.0	157.2	F		
Westbound												
LTR	0.94	0.28	21.0	1.000	1338	0.50	8.2	0.0	29.3	C	29.3	C
Northbound												
L	1.19	0.33	20.0	1.000	139	0.50	132.2	0.0	152.2	F	71.1	E
T	0.40	0.33	15.4	1.000	621	0.50	1.8	0.0	17.1	B		
Southbound												
TR	0.69	0.33	17.3	1.000	707	0.50	4.1	0.0	21.4	C	21.4	C

Intersection delay = 48.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			165	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			486	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.75	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.10	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			10.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.17	
n=Max(gq-gf)/2,0)			5.41	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.06	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.22	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.223	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.274 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.83	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.541	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			486	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.158	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.7
	0.0						0.0	
R	0.0	0.00	26.0	26.0	0.00	13.0	0.0	157.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	21.0	0.00	0.0	0.0	29.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	20.0	0.00	6.5	0.0	152.2
T	0.0	0.00	20.0	15.4	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	17.3	0.00	0.0	0.0	21.4
	0.0						0.0	

Intersection Delay	48.8	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	27	272		463		165	248		486
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1734		416	1863		2121
LnCapacity	222	220		491		139	621		707
Flow Ratio	0.0	0.2		0.3		0.4	0.1		0.2
v/c Ratio	0.12	1.24		0.94		1.19	0.40		0.69
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.717		0.483			0.917		0.747
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.4	4.5		7.5		2.8	3.2		7.0
kB	0.2	0.2		0.3		0.2	0.6		0.5
Q2	0.0	7.5		2.5		4.2	0.4		1.1
Q Average	0.4	12.0		10.0		7.0	3.6		8.1
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.2	1.2		1.2
BOQ	0.6	14.5		12.1		8.5	4.4		9.8
QSRatio									
85th Percentile Output:									
fB%	1.7	1.4		1.4		1.5	1.5		1.5
BOQ	0.7	17.1		14.4		10.3	5.5		11.8
QSRatio									
90th Percentile Output:									
fB%	2.0	1.5		1.6		1.6	1.7		1.6
BOQ	0.8	18.6		15.7		11.3	6.2		12.9
QSRatio									
95th Percentile Output:									
fB%	2.5	1.7		1.7		1.8	2.1		1.8
BOQ	1.1	20.3		17.4		12.9	7.4		14.5
QSRatio									
98th Percentile Output:									
fB%	3.1	1.8		1.9		2.1	2.4		2.0
BOQ	1.3	22.0		19.0		14.4	8.7		16.1
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	31	33	5				3	349	152	325	540	47
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.20 0.28 17.3 B 17.3 B

Westbound

Northbound

LTR 972 1768 0.56 0.55 10.9 B 10.9 B

Southbound

L 447 812 0.81 0.55 20.7 C
 TR 1025 1864 0.62 0.55 11.1 B 14.6 B

Intersection Delay = 13.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	31	33	5				3	349	152	325	540	47
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	11	2				1	95	41	90	150	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		91						547		361	640	
%InSharedLn												
Prop LTs		0.451						0.005		1.000	0.000	
Prop RTs		0.077						0.302			0.063	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						0		0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left					SB	Left	P	
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0						33.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	31	33	5				3	349	152	325	540	47
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	41	43	7				3	379	165	361	600	40
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow	91						547			361	640	
Prop LTs	0.451						0.005			1.000	0.000	
Prop RTs	0.077						0.302			0.063		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound			
LG	LTR						LTR			L	TR		
So	1900						1900			1900	1900		
Lanes	0	1	0	0	0	0	0	1	0	1	1	0	
fW	1.033							1.133			1.000	1.000	
fHV	0.980							0.980			0.990	0.990	
fG	1.000							1.000			1.000	1.000	
fP	0.875							0.875			1.000	1.000	
fBB	1.000							1.000			1.000	1.000	
fA	1.000							1.000			1.000	1.000	
fLU	1.000							1.000			1.000	1.000	
fRT	0.990							0.959				0.991	
fLT	0.978							0.998			0.431	1.000	
Sec.													
fLpb	1.000							1.000			1.000	1.000	
fRpb	1.000							1.000				1.000	
S	1630							1768			812	1864	
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	91	1630	# 0.06	0.28	462	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	547	1768	0.31	0.55	972	0.56
Right							
Southbound							
Prot							
Perm							
Left	L	361	812	# 0.44	0.55	447	0.81
Prot							
Perm							
Thru	TR	640	1864	0.34	0.55	1025	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.20	0.28	16.3	1.000	462	0.50	1.0	0.0	17.3	B	17.3	B
Westbound												
Northbound												
LTR	0.56	0.55	8.8	1.000	972	0.50	2.1	0.0	10.9	B	10.9	B
Southbound												
L	0.81	0.55	10.9	1.000	447	0.50	9.8	0.0	20.7	C		
TR	0.62	0.55	9.3	1.000	1025	0.50	1.9	0.0	11.1	B	14.6	B

Intersection delay = 13.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				361
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				547
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				6.02
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				9.12
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				6.41
gu=g-gq if gq>=gf, or = g-gf if gq<gf				26.59
n=Max(gq-gf)/2,0)				3.21
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.18
EL2=Max((1-Ptho**n)/Plto, 1.0)				3.19
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.12
gdiff=max(gq-gf,0)				6.41
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.43
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.431

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.451
Proportion of LT in opposing flow, PLTo	0.005 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	640
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.67
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	7.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.64
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.86	6.41
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.238	0.194
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			640	547
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.005	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.077	0.302	0.063
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.8	0.00	0.0	0.0	10.9
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	10.9	0.00	0.0	0.0	20.7
TR	0.0	0.00	13.5	9.3	0.00	0.0	0.0	11.1
	0.0						0.0	

Intersection Delay	13.5	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR						LTR		L	TR	
Init Queue		0.0						0.0		0.0	0.0	
Flow Rate		91						547		361	640	
So		1900						1900		1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL		1630						1768		812	1864	
LnCapacity		462						972		447	1025	
Flow Ratio		0.1						0.3		0.4	0.3	
v/c Ratio		0.20						0.56		0.81	0.62	
Grn Ratio		0.28						0.55		0.55	0.55	
I Factor		1.000						0.899			0.644	
AT or PVG		3						3		3	3	
Pltn Ratio		1.00						1.00		1.00	1.00	
PF2		1.00						1.00		1.00	1.00	
Q1		1.2						5.9		4.9	7.3	
kB		0.5						0.8		0.3	0.6	
Q2		0.1						1.0		1.2	0.9	
Q Average		1.3						6.9		6.1	8.2	
Q Spacing		25.0						25.0		25.0	25.0	
Q Storage		0						0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%		1.3						1.2		1.2	1.2	
BOQ		1.6						8.5		7.5	10.0	
QSRatio												
85th Percentile Output:												
fB%		1.6						1.5		1.5	1.5	
BOQ		2.1						10.2		9.0	12.0	
QSRatio												
90th Percentile Output:												
fB%		1.9						1.6		1.6	1.6	
BOQ		2.4						11.2		10.0	13.1	
QSRatio												
95th Percentile Output:												
fB%		2.4						1.9		1.9	1.8	
BOQ		3.0						12.8		11.5	14.8	
QSRatio												
98th Percentile Output:												
fB%		2.9						2.1		2.1	2.0	
BOQ		3.6						14.3		13.0	16.4	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	8	18	293	18	105	13	349	241	86	446	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 631 1420 0.06 0.44 14.5 B 14.5 B

Westbound

L 578 1301 0.56 0.44 22.0 C
 T 808 1818 0.02 0.44 14.1 B 20.1 C
 R 601 1352 0.19 0.44 15.8 B

Northbound

LTR 743 1672 0.88 0.44 30.9 C 30.9 C

Southbound

LTR 606 1363 0.99 0.44 48.8 D 48.8 D

Intersection Delay = 33.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	8	18	293	18	105	13	349	241	86	446	8
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	81	5	29	4	95	65	24	124	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		41		326	20	117		655			601	
%InSharedLn												
Prop LTs		0.244		1.000	0.000			0.021			0.160	
Prop RTs		0.512			0.000	1.000		0.400			0.015	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	8	18	293	18	105	13	349	241	86	446	8
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	10	10	21	326	20	117	14	379	262	96	496	9
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	41			326	20	117	655			601		
Prop LTs	0.244			1.000	0.000	0.000	0.021			0.160		
Prop RTs	0.512			0.000 1.000			0.400			0.015		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.980			0.990	0.990	0.990	1.000			0.990		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	1.000			1.000	1.000	1.000	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.931			1.000 0.850			0.946			0.998		
fLT	0.964			0.730 1.000			0.985			0.728		
Sec.												
fLpb	1.000			0.947 1.000			1.000			0.997		
fRpb	0.971			1.000 1.000			0.978			1.000		
S	1420			1301 1818 1352			1672			1363		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1420	0.03	0.44	631	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	326	1301	# 0.25	0.44	578	0.56
Prot							
Perm							
Thru	T	20	1818	0.01	0.44	808	0.02
Right	R	117	1352	0.09	0.44	601	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	655	1672	0.39	0.44	743	0.88
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	601	1363	# 0.44	0.44	606	0.99
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.69$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.78$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	631	0.50	0.2	0.0	14.5	B	14.5	B
Westbound												
L	0.56	0.44	18.5	1.000	578	0.50	3.5	0.0	22.0	C		
T	0.02	0.44	14.0	1.000	808	0.50	0.1	0.0	14.1	B	20.1	C
R	0.19	0.44	15.2	1.000	601	0.50	0.6	0.0	15.8	B		
Northbound												
LTR	0.88	0.44	22.8	1.000	743	0.50	8.1	0.0	30.9	C	30.9	C
Southbound												
LTR	0.99	0.44	24.8	1.000	606	0.50	24.0	0.0	48.8	D	48.8	D

Intersection delay = 33.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		326		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.24		
Adjusted opposing flow rate, Vo (veh/h)		41		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		8.15		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.02		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.76		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.730		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	14	96
Proportion of LT in LT lane group, PLT	0.244	0.000	0.021
Proportion of LT in opposing flow, PLTo	0.00	0.16	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	601	655
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.35	2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	15.02	16.38
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	20.6	4.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.89	17.30
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	19.35	22.70
n=Max(gq-gf)/2,0)	0.00	0.00	6.65
PTHo=1-PLTo	1.00	0.84	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.24	0.02	0.16
EL1 (refer to Exhibit C16-3)	1.40	2.54	2.68
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	6.26
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	13.30
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96	0.98	0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.964	0.985	0.728

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.89	17.30
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.397	0.433
OCCpedu	0.000	0.056	0.000	0.044
Opposing flow rate, Vo (veh/h)	20	41	601	655
OCCr	0.000	0.053	0.000	0.018
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.982
Proportion of left turns, PLT	0.244	1.000	0.021	0.160
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.997
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.512	1.000	0.400	0.015
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.3	0.00	0.0	0.0	14.5
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.5	0.00	0.0	0.0	22.0
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	22.8	0.00	0.0	0.0	30.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	24.8	0.00	0.0	0.0	48.8
	0.0						0.0	
Intersection Delay			33.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		41	326	20	117		655		601
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1420	1301	1818	1352		1672		1363
LnCapacity		631	578	808	601		743		606
Flow Ratio		0.0	0.3	0.0	0.1		0.4		0.4
v/c Ratio		0.06	0.56	0.02	0.19		0.88		0.99
Grn Ratio		0.44	0.44	0.44	0.44		0.44		0.44
I Factor		1.000		0.887			0.516		0.500
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.6	6.0	0.3	1.8		15.0		14.9
kB		0.8	0.7	0.9	0.7		0.5		0.4
Q2		0.1	0.9	0.0	0.2		2.8		5.2
Q Average		0.6	6.9	0.3	1.9		17.8		20.1
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.8	8.5	0.4	2.5		21.4		24.2
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.1	10.2	0.5	3.1		25.1		28.3
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.2	11.2	0.6	3.6		26.9		30.4
QSRatio									
95th Percentile Output:									
fB%		2.5	1.9	2.5	2.3		1.6		1.6
BOQ		1.6	12.8	0.8	4.4		29.0		32.6
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.7		1.7
BOQ		1.9	14.4	0.9	5.3		31.0		34.7
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: AECOM Area Type: All other areas
 Date: 6/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	238		239	312		246	151		255			
Lane Width	16.0			16.0			11.0					
RTOR Vol			56						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	986	1971	0.55	0.50	17.5	B	17.5	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	424	848	1.48	0.50	250.3	F	250.3	F
----	-----	-----	------	------	-------	---	-------	---

Northbound

LR	556	1430	0.86	0.39	40.5	D	40.5	D
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 112.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 6/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		238	239	312	246		151		255			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		76	77	88	69		44		75			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		540			627			478				
%InSharedLn												
Prop LTs		0.000			0.560			0.372				
Prop RTs		0.435			0.000			0.628				
Peds Bikes	0						0			0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		238	239	312	246		151		255			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		305	235	351	276		178		300			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		540			627			478				
Prop LTs		0.000			0.560			0.372				
Prop RTs		0.435			0.000			0.628				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.941			1.000			0.915					
fLT	1.000			0.409			0.982					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1971			848			1430					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.55	0.50	15.5	1.000	986	0.50	2.0	0.0	17.5	B	17.5	B
Westbound												
LT	1.48	0.50	22.5	1.000	424	0.50	227.8	0.0	250.3	F	250.3	F
Northbound												
LR	0.86	0.39	25.2	1.000	556	0.50	15.2	0.0	40.5	D	40.5	D
Southbound												

Intersection delay = 112.9 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	351		
Proportion of LT in LT lane group, PLT	0.000	0.560	0.372
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	540		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	8.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	12.22		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.78		
n=Max(gq-gf)/2,0)	6.11		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.56		
EL1 (refer to Exhibit C16-3)	2.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.41		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.409		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	15.5	0.00	0.0	0.0	17.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	22.5	0.00	50.8	0.0	250.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.2	0.00	0.0	0.0	40.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			112.9	sec/veh	Intersection LOS F			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		540			627			478				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1971			848			1430				
LnCapacity		986			424			556				
Flow Ratio		0.3			0.7			0.3				
v/c Ratio		0.55			1.48			0.86				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		9.3			15.7			11.0				
kB		1.0			0.6			0.7				
Q2		1.2			27.2			3.3				
Q Average		10.5			42.8			14.3				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		12.8			51.4			17.2				
QSRatio												
85th Percentile Output:												
fB%		1.4			1.4			1.4				
BOQ		15.1			60.0			20.2				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.5				
BOQ		16.4			64.3			21.8				
QSRatio												
95th Percentile Output:												
fB%		1.7			1.6			1.7				
BOQ		18.1			68.6			23.7				
QSRatio												
98th Percentile Output:												
fB%		1.9			1.7			1.8				
BOQ		19.8			72.8			25.5				
QSRatio												

ERROR MESSAGES

No errors to report.

Mitigation

2015

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/8/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 Miti-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				58		136	497	72		89	320	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 384 1440 0.54 0.27 24.2 C 24.2 C

Northbound

TR 1032 1821 0.65 0.57 11.4 B 11.4 B

Southbound

L 291 514 0.35 0.57 9.8 A
 T 911 1607 0.40 0.57 8.4 A 8.7 A

Intersection Delay = 12.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				58		136	497	72		89	320	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				16		37	146	21		26	92	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					208			670		102	368	
%InSharedLn												
Prop LTs					0.298			0.000		1.000	0.000	
Prop RTs					0.702			0.127			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.980			0.769				0.842	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				58		136	497	72		89	320	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				62		146	585	85		102	368	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					208			670		102	368	
Prop LTs					0.298			0.000		1.000	0.000	
Prop RTs					0.702			0.127			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.971			0.901			0.917	0.917	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.984			1.000	0.988	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.905			0.983				1.000	
fLT				0.985			1.000			0.316	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1440			1821			514	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	208	1440	# 0.14	0.27	384	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	670	1821	# 0.37	0.57	1032	0.65
Right							
Southbound							
Prot							
Perm							
Left	L	102	514	0.20	0.57	291	0.35
Prot							
Perm							
Thru	T	368	1607	0.23	0.57	911	0.40
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.51
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.61

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.54	0.27	18.9	1.000	384	0.50	5.3	0.0	24.2	C	24.2	C
Northbound												
TR	0.65	0.57	8.9	1.000	1032	0.50	2.4	0.0	11.4	B	11.4	B
Southbound												
L	0.35	0.57	7.0	1.000	291	0.50	2.8	0.0	9.8	A		
T	0.40	0.57	7.3	1.000	911	0.50	1.1	0.0	8.4	A	8.7	A

Intersection delay = 12.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				102
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				670
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				1.70
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				11.17
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				7.80
gu=g-gq if gq>=gf, or = g-gf if gq<gf				26.20
n=Max(gq-gf)/2,0)				3.90
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.44
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.32
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.316

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.298 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.80
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.229
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				670
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.702	0.127
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	18.9	0.00	0.0	0.0	24.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.9	0.00	0.0	0.0	11.4
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	7.0	0.00	0.0	0.0	9.8
T	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.4
	0.0						0.0	

Intersection Delay	12.4	sec/veh	Intersection LOS	B
--------------------	------	---------	------------------	---

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					208		670	102	368
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1440		1821	514	1607
LnCapacity					384		1032	291	911
Flow Ratio					0.1		0.4	0.2	0.2
v/c Ratio					0.54		0.65	0.35	0.40
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.980		0.769		0.842
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					3.0		7.7	0.9	3.4
kB					0.4		0.7	0.3	0.7
Q2					0.5		1.2	0.2	0.5
Q Average					3.5		8.9	1.1	3.9
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					4.3		10.8	1.4	4.9
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5	1.6	1.5
BOQ					5.4		12.9	1.8	6.0
QSRatio									
90th Percentile Output:									
fB%					1.7		1.6	1.9	1.7
BOQ					6.1		14.1	2.1	6.7
QSRatio									
95th Percentile Output:									
fB%					2.1		1.8	2.4	2.1
BOQ					7.3		15.7	2.6	8.0
QSRatio									
98th Percentile Output:									
fB%					2.4		2.0	2.9	2.4
BOQ					8.5		17.3	3.1	9.3
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/28/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 Miti-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	52	32	135	172	394	6	229	91	50	10	157	99
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	49.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	1231	2261	0.20	0.54	10.8	B	10.8	B
-----	------	------	------	------	------	---	------	---

Westbound

LTR	1457	2676	0.45	0.54	13.3	B	13.3	B
-----	------	------	------	------	------	---	------	---

Northbound

DefL	333	967	0.79	0.34	43.8	D		
TR	616	1788	0.26	0.34	22.3	C	35.6	D

Southbound

LTR	942	2736	0.37	0.34	23.3	C	23.3	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 20.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	52	32	135	172	394	6	229	91	50	10	157	99
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	38	49	113	2	66	26	14	3	52	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		248			658		263	162			350	
%InSharedLn												
Prop LTs		0.238			0.301		1.000	0.000			0.037	
Prop RTs		0.617			0.011			0.352			0.371	
Peds Bikes	0	0		0	0		0	0	0	0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		49.0						31.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	52	32	135	172	394	6	229	91	50	10	157	99
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	59	36	153	198	453	7	263	105	57	13	207	130
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	248			658			263 162			350		
Prop LTs	0.238			0.301			1.000 0.000			0.037		
Prop RTs	0.617			0.011			0.352			0.371		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.907			0.998			0.947			0.944		
fLT	0.744			0.763			0.512 1.000			0.944		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2261			2676			967 1788			2736		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	248	2261	0.11	0.54	1231	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	658	2676	# 0.25	0.54	1457	0.45
Right							
Northbound							
Prot							
Perm							
Left	DefL	263	967	# 0.27	0.34	333	0.79
Prot							
Perm							
Thru	TR	162	1788	0.09	0.34	616	0.26
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	350	2736	0.13	0.34	942	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.52

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.20	0.54	10.5	1.000	1231	0.50	0.3	0.0	10.8	B	10.8	B
Westbound												
LTR	0.45	0.54	12.4	1.000	1457	0.50	1.0	0.0	13.3	B	13.3	B
Northbound												
DefL	0.79	0.34	26.6	1.000	333	0.50	17.2	0.0	43.8	D		
TR	0.26	0.34	21.3	1.000	616	0.50	1.0	0.0	22.3	C	35.6	D
Southbound												
LTR	0.37	0.34	22.2	1.000	942	0.50	1.1	0.0	23.3	C	23.3	C

Intersection delay = 20.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			263	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			350	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			6.58	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.60	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.66	
gq, (see Exhibit C16-4,5,6,7,8)			1.71	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			29.29	
n=Max(gq-gf)/2,0)			0.86	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.84	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.13	
gdifff=max(gq-gf,0)			1.71	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.51	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.512	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	49.0	49.0		31.0
Effective permitted green time for LT lane group, g(s)	49.0	49.0		31.0
Opposing effective green time, go (s)	49.0	49.0		31.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	59	198	13
Proportion of LT in LT lane group, PLT	0.238	0.301	0.000
Proportion of LT in opposing flow, PLTo	0.30	0.24	0.00
Adjusted opposing flow rate, Vo (veh/h)	658	248	162
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.48	4.95	0.33
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.64	3.26	2.03
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.3	0.0	15.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.46	0.46	0.66
gq, (see Exhibit C16-4,5,6,7,8)	4.74	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	38.72	49.00	15.09
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	0.70	0.76	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.65	0.77	0.08
EL1 (refer to Exhibit C16-3)	2.77	1.81	1.63
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07	0.07
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.58	0.62	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.744	0.763	0.944

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	49.0	49.0		31.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	4.74	0.00		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.097	0.000		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	658	248		162
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.238	0.301		0.037
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	49.0	49.0	31.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	49.0	49.0	31.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.617	0.011	0.352
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	10.5	0.00	0.0	0.0	10.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	12.4	0.00	0.0	0.0	13.3
	0.0						0.0	
Northbound								
DefL	0.0	0.00	29.5	26.6	0.00	0.0	0.0	43.8
TR	0.0	0.00	29.5	21.3	0.00	0.0	0.0	22.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	22.2	0.00	0.0	0.0	23.3
	0.0						0.0	

Intersection Delay	20.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	130		345		263	162	183	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0		0 2 0		0 2 0		0 2 0	
SL	1187		1405		967	1788	1436	
LnCapacity	646		765		333	616	494	
Flow Ratio	0.1		0.2		0.3	0.1	0.1	
v/c Ratio	0.20		0.45		0.79	0.26	0.37	
Grn Ratio	0.54		0.54		0.34	0.34	0.34	
I Factor	0.916		0.953			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	1.7		5.2		5.9	2.9	3.4	
kB	0.8		0.9		0.5	0.8	0.7	
Q2	0.2		0.7		1.7	0.3	0.4	
Q Average	1.9		5.9		7.6	3.2	3.8	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2		1.2	1.3	1.2	
BOQ	2.4		7.3		9.3	4.0	4.8	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.5		1.5	1.6	1.5	
BOQ	3.0		8.9		11.1	5.0	5.9	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.7		1.6	1.8	1.7	
BOQ	3.4		9.8		12.2	5.7	6.7	
QSRatio								
95th Percentile Output:								
fB%	2.3		1.9		1.8	2.1	2.1	
BOQ	4.3		11.3		13.8	6.8	7.9	
QSRatio								
98th Percentile Output:								
fB%	2.7		2.2		2.0	2.5	2.4	
BOQ	5.1		12.8		15.4	8.0	9.2	
QSRatio								

ERROR MESSAGES

No errors to report.

Inter.: Boscombe Ave & OBX Off-Ramp
Area Type: All other areas
Jurisd: Staten Island, NY
Year : 2015 FULL Mitigation

N/S St: Outerbridge Crossing Off-Ramp

Eastbound								
L	856	1728	0.98	0.71	37.9	D		
TR	1157	1627	0.24	0.71	4.8	A	29.8	C
Westbound								
LT	449	1835	0.70	0.24	39.1	D	20.6	C
R	1568	1568	0.18	1.00	0.2	A		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.54	0.18	42.6	D		
LT	320	1801	0.02	0.18	30.6	C	22.4	C
R	952	1478	0.17	0.64	6.8	A		
Intersection Delay = 26.2 (sec/veh) Intersection LOS = C								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	767	231	19	4	265	245	4	16	6	106	5	140
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	211	63	5	1	77	71	3	11	4	30	2	40
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	843	275			313	285		70		122	6	161
%InSharedLn										0		
Prop LTS	1.000	0.000			0.016			0.157		1.000	0.000	
Prop RTS		0.076			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	767	231	19		4	265	245		4	16	6		106	5	140
PHF	0.91	0.91	0.91		0.86	0.86	0.86		0.37	0.37	0.37		0.87	0.87	0.87
Adj flow	843	254	21		5	308	285		11	43	16		122	6	161
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	843	275				313	285			70			122	6	161
Prop LTs	1.000	0.000				0.016				0.157			1.000	0.000	
Prop RTs		0.076				0.000	1.000			0.229				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.989			1.000	0.850			0.969					1.000	0.850
fLT	0.950	1.000			0.995				0.965				0.732	1.000	
Sec.	0.268														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1627			1835	1568			1995				1273	1801	1478
Sec.	487														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		133	487	# 0.27	0.300	146	0.91
Left	L	843			0.71	856	0.98
Prot							
Perm							
Thru	TR	275	1627	0.17	0.71	1157	0.24
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	313	1835	0.17	0.24	449	0.70
Right	R	285	1568	0.18	1.00	1568	0.18
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	122	1273	# 0.10	0.18	226	0.54
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	161	1478	0.11	0.64	952	0.17

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.78

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.98	0.71	17.4	1.000	856	0.50	20.5	0.0	37.9	D			
TR	0.24	0.71	4.5	1.000	1157	0.50	0.3	0.0	4.8	A	29.8	C	
Westbound													
LT	0.70	0.24	31.0	1.000	449	0.50	8.1	0.0	39.1	D	20.6	C	
R	0.18	1.00	0.0	0.950	1568	0.50	0.2	0.0	0.2	A			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.54	0.18	33.7	1.000	226	0.50	9.0	0.0	42.6	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	22.4	C	

R 0.17 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 26.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	843			122
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.02			0.16
Adjusted opposing flow rate, Vo (veh/h)	313			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.08			3.05
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.82			1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	14.31			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.69			14.85
n=Max(gq-gf)/2,0)	7.16			0.58
PTHo=1-PLTo	0.98			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.75			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	6.81			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	14.31			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.27			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.268			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.016	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	275	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.88	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.83	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		275		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.016		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.076
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	843			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	14.31			
Unopposed green interval, gu	12.69			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.29			
XPerm	1.73			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	8.76			
Queue at beginning of unsaturated green, Qu	3.35			
Residual queue, Qr	2.67			
Uniform Delay, d1	17.4			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		17.4	0.00	0.0	0.0	37.9
TR	0.0	0.00	13.0	4.5	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.0	0.00	0.0	0.0	39.1
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.2
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.6
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8

Intersection Delay	26.2	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	843	275		313	285		70	122	6	161
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1204	1627		1835	1568		1995	1273	1801	1478
LnCapacity	856	1157		449	1568		355	226	320	952
Flow Ratio	0.7	0.2		0.2	0.2		0.0	0.1	0.0	0.1
v/c Ratio	0.98	0.24		0.70	0.18		0.20	0.54	0.02	0.17
Grn Ratio	0.71	0.71		0.24	1.00		0.18	0.18	0.18	0.64
I Factor		0.603		0.932			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00			1.00	1.00	1.00	1.00
Q1	10.2	2.4		7.1			1.5	2.8	0.1	1.6
kB	0.6	0.8		0.6	1.5		0.6	0.4	0.5	1.1
Q2	7.3	0.2		1.3	0.3		0.1	0.5	0.0	0.2
Q Average	17.5	2.6		8.4			1.6	3.2	0.1	1.8
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2			1.3	1.3	1.3	1.3
BOQ	21.1	3.3		10.3			2.1	4.0	0.2	2.3
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.5			1.6	1.6	1.7	1.6
BOQ	24.7	4.1		12.3			2.6	5.0	0.2	2.9
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6			1.9	1.8	2.0	1.8
BOQ	26.6	4.7		13.4			3.0	5.7	0.3	3.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.2		1.8			2.3	2.1	2.6	2.3
BOQ	28.6	5.8		15.0			3.8	6.9	0.3	4.2
QSRatio										
98th Percentile Output:										
fB%	1.7	2.6		2.0			2.8	2.5	3.2	2.7
BOQ	30.6	6.8		16.7			4.5	8.0	0.4	5.0
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	7	20	12	166	16	101	9	176	127	134	297	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 635 1465 0.09 0.43 15.3 B 15.3 B

Westbound

L 534 1233 0.35 0.43 18.8 B
 T 758 1749 0.02 0.43 14.7 B 17.8 B
 R 559 1291 0.21 0.43 16.7 B

Northbound

LTR 710 1559 0.49 0.46 19.2 B 19.2 B

Southbound

LTR 575 1263 1.01 0.46 37.0 D 37.0 D

Intersection Delay = 26.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	7	20	12	166	16	101	9	176	127	134	297	8
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	4	47	5	29	3	49	35	44	98	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		189	18	115		347			578	
%InSharedLn												
Prop LTs		0.175		1.000	0.000			0.029			0.304	
Prop RTs		0.316			0.000	1.000		0.406			0.019	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.966			0.850			0.090	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		39.0						41.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	7	20	12	166	16	101	9	176	127	134	297	8
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	10	29	18	189	18	115	10	196	141	176	391	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	57			189 18 115			347			578		
Prop LTs	0.175			1.000 0.000			0.029			0.304		
Prop RTs	0.316			0.000 1.000			0.406			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L T R			LTR			LTR		
So	1900			1900 1900 1900			1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000 0.967 0.967			0.967			1.000		
fHV	0.971			0.952 0.952 0.952			0.935			0.935		
fG	1.000			1.000 1.000 1.000			1.000			1.000		
fP	0.875			1.000 1.000 0.875			1.000			1.000		
fBB	0.992			1.000 1.000 0.992			1.000			1.000		
fA	1.000			1.000 1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000 1.000			1.000			1.000		
fRT	0.957			1.000 0.850			0.945			0.997		
fLT	0.973			0.720 1.000			0.983			0.720		
Sec.												
fLpb	1.000			0.947 1.000			1.000			0.991		
fRpb	0.982			1.000 1.000			0.978			1.000		
S	1465			1233 1749 1291			1559			1263		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1465	0.04	0.43	635	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	189	1233	# 0.15	0.43	534	0.35
Prot							
Perm							
Thru	T	18	1749	0.01	0.43	758	0.02
Right	R	115	1291	0.09	0.43	559	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	347	1559	0.22	0.46	710	0.49
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	578	1263	# 0.46	0.46	575	1.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.69

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.43	15.0	1.000	635	0.50	0.3	0.0	15.3	B	15.3	B
Westbound												
L	0.35	0.43	17.1	1.000	534	0.50	1.8	0.0	18.8	B		
T	0.02	0.43	14.6	1.000	758	0.50	0.1	0.0	14.7	B	17.8	B
R	0.21	0.43	15.9	1.000	559	0.50	0.8	0.0	16.7	B		
Northbound												
LTR	0.49	0.46	17.2	1.000	710	0.50	2.0	0.0	19.2	B	19.2	B
Southbound												
LTR	1.01	0.46	24.5	1.000	575	0.50	12.5	0.0	37.0	D	37.0	D

Intersection delay = 26.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		189		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.18		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.72		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.82		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gfgq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	10	176
Proportion of LT in LT lane group, PLT	0.175	0.000	0.029
Proportion of LT in opposing flow, PLTo	0.00	0.30	0.03
Adjusted opposing flow rate, Vo (veh/h)	18	578	347
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.25	4.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45	14.45	8.68
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.1	23.6	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57	0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.85	8.45
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.86	17.38	32.55
n=Max(gq-gf)/2,0)	0.00	0.00	4.23
PTHo=1-PLTo	1.00	0.70	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.18	0.03	0.30
EL1 (refer to Exhibit C16-3)	1.40	2.48	1.97
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.03
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	8.45
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97	0.98	0.72
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.973	0.983	0.720

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	14.85	8.45
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.362	0.206
OCCpedu	0.000	0.058	0.000	0.049
Opposing flow rate, Vo (veh/h)	18	57	578	347
OCCr	0.000	0.053	0.000	0.030
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.970
Proportion of left turns, PLT	0.175	1.000	0.029	0.304
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.991
Permitted Right Turns				
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.316	1.000	0.406	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.5	15.0	0.00	0.0	0.0	15.3
	0.0						0.0	
Westbound								
L	0.0	0.00	25.5	17.1	0.00	0.0	0.0	18.8
T	0.0	0.00	25.5	14.6	0.00	0.0	0.0	14.7
R	0.0	0.00	25.5	15.9	0.00	0.0	0.0	16.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	24.5	17.2	0.00	0.0	0.0	19.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	24.5	24.5	0.00	0.8	0.0	37.0
	0.0						0.0	
Intersection Delay			26.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	57		189	18	115	347		578	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1465		1233	1749	1291	1559		1263	
LnCapacity	635		534	758	559	710		575	
Flow Ratio	0.0		0.2	0.0	0.1	0.2		0.5	
v/c Ratio	0.09		0.35	0.02	0.21	0.49		1.01	
Grn Ratio	0.43		0.43	0.43	0.43	0.46		0.46	
I Factor	1.000		0.966			0.850		0.090	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.8		3.2	0.3	1.8	6.1		14.4	
kB	0.8		0.7	0.9	0.7	0.8		0.1	
Q2	0.1		0.4	0.0	0.2	0.7		2.4	
Q Average	0.9		3.5	0.3	2.0	6.8		16.9	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	1.2		4.4	0.4	2.5	8.3		20.3	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.5	1.7	1.6	1.5		1.4	
BOQ	1.5		5.5	0.5	3.2	10.0		23.8	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.7	2.0	1.8	1.6		1.5	
BOQ	1.8		6.2	0.6	3.6	11.1		25.6	
QSRatio									
95th Percentile Output:									
fB%	2.4		2.1	2.5	2.3	1.9		1.6	
BOQ	2.2		7.4	0.7	4.5	12.6		27.6	
QSRatio									
98th Percentile Output:									
fB%	2.9		2.4	3.1	2.7	2.1		1.8	
BOQ	2.7		8.7	0.9	5.4	14.2		29.6	
QSRatio									

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				97		185	443	77		175	439	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 386 1446 0.84 0.27 39.1 D 39.1 D

Northbound

TR 1057 1866 0.54 0.57 9.8 A 9.8 A

Southbound

L 350 617 0.58 0.57 11.9 B
 T 933 1646 0.55 0.57 9.3 A 10.0+ B

Intersection Delay = 15.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				97		185	443	77		175	439	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				28		53	120	21		51	128	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					324			566		203	510	
%InSharedLn												
Prop LTs					0.343			0.000		1.000	0.000	
Prop RTs					0.657			0.148		0.000		
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet					0.0			0.0		0.0	0.0	
Arriv. Type					3			3		3	3	
Unit Ext.					3.0			3.0		3.0	3.0	
I Factor					0.944			0.880			0.500	
Lost Time					2.0			2.0		2.0	2.0	
Ext of g					2.0			2.0		2.0	2.0	
Ped Min g		11.8			11.8			14.1				

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				97		185	443	77		175	439	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				111		213	482	84		203	510	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					324			566		203	510	
Prop LTs					0.343			0.000		1.000	0.000	
Prop RTs					0.657			0.148			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR		L	T	
So					1900			1900		1900	1900	
Lanes	0	0	0	0	0	0	0	1	0	1	1	0
fW					1.000			1.100		0.933	0.933	
fHV					0.971			0.926		0.943	0.943	
fG					1.000			1.000		1.000	1.000	
fP					0.875			1.000		1.000	1.000	
fBB					1.000			0.984		1.000	0.984	
fA					1.000			1.000		1.000	1.000	
FLU					1.000			1.000		1.000	1.000	
fRT					0.911			0.980			1.000	
fLT					0.983			1.000		0.369	1.000	
Sec.												
fLpb					1.000			1.000		1.000	1.000	
fRpb					1.000			1.000			1.000	
S					1446			1866		617	1646	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	324	1446	# 0.22	0.27	386	0.84
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	566	1866	0.30	0.57	1057	0.54
Right							
Southbound							
Prot							
Perm							
Left	L	203	617	# 0.33	0.57	350	0.58
Prot							
Perm							
Thru	T	510	1646	0.31	0.57	933	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.84	0.27	20.8	1.000	386	0.50	18.3	0.0	39.1	D	39.1	D
Northbound												
TR	0.54	0.57	8.1	1.000	1057	0.50	1.7	0.0	9.8	A	9.8	A
Southbound												
L	0.58	0.57	8.4	1.000	350	0.50	3.5	0.0	11.9	B		
T	0.55	0.57	8.2	1.000	933	0.50	1.2	0.0	9.3	A	10.0+	B

Intersection delay = 15.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				203
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				566
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				3.38
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				9.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				6.26
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.74
n=Max(gq-gf)/2,0)				3.13
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.21
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.37
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.369

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.343 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.26
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.184
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				566
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.657	0.148
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.8	0.00	0.0	0.0	39.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.1	0.00	0.0	0.0	9.8
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	8.4	0.00	0.0	0.0	11.9
T	0.0	0.00	13.0	8.2	0.00	0.0	0.0	9.3
	0.0						0.0	

Intersection Delay	15.8	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					324		566	203	510
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1446		1866	617	1646
LnCapacity					386		1057	350	933
Flow Ratio					0.2		0.3	0.3	0.3
v/c Ratio					0.84		0.54	0.58	0.55
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.944		0.880		0.500
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					5.1		5.9	2.2	5.3
kB					0.4		0.8	0.2	0.4
Q2					1.8		0.9	0.3	0.5
Q Average					6.9		6.8	2.5	5.8
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					8.4		8.3	3.1	7.2
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5	1.6	1.5
BOQ					10.1		10.0	3.9	8.7
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.8	1.7
BOQ					11.2		11.0	4.4	9.6
QSRatio									
95th Percentile Output:									
fB%					1.9		1.9	2.2	1.9
BOQ					12.7		12.6	5.4	11.1
QSRatio									
98th Percentile Output:									
fB%					2.1		2.1	2.6	2.2
BOQ					14.3		14.1	6.4	12.6
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/10/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2015 Miti-Action Conditions

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	147	221	140	207	578	55	104	216	216	48	58	88
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		P
	Thru	P					Thru		P
	Right	P					Right		P
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		36.0					20.0	19.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	216	540	0.81	0.40	47.8	D		
TR	715	1788	0.55	0.40	23.3	C	30.9	C
Westbound								
L	256	640	0.90	0.40	58.6	E		
TR	1351	3378	0.51	0.40	21.6	C	30.9	C
Northbound								
LTR	731	3291	0.79	0.22	41.4	D	41.4	D
Southbound								
L	361	1711	0.17	0.21	30.0	C		
TR	334	1581	0.54	0.21	37.8	D	35.9	D

Intersection Delay = 34.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	147	221	140	207	578	55	104	216	216	48	58	88
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	66	42	58	161	15	28	58	58	15	18	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	175	392		230	689			576		60	182	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.194			0.000	
Prop RTs		0.329			0.068			0.403			0.604	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		36.0						20.0	19.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	147	221	140	207	578	55	104	216	216	48	58	88
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	175	263	129	230	642	47	112	232	232	60	72	110
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	175	392		230	689			576		60	182	
Prop LTs	1.000	0.000		1.000	0.000			0.194			0.000	
Prop RTs		0.329			0.068			0.403			0.604	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.990	0.990		0.943	0.943			0.962		0.980	0.980	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.951			0.990			0.940			0.909	
fLT	0.297	1.000		0.383	1.000			0.990		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	540	1788		640	3378			3291		1711	1581	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	175	540	0.32	0.40	216	0.81
Prot							
Perm							
Thru	TR	392	1788	0.22	0.40	715	0.55
Right							
Westbound							
Prot							
Perm							
Left	L	230	640	# 0.36	0.40	256	0.90
Prot							
Perm							
Thru	TR	689	3378	0.20	0.40	1351	0.51
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	576	3291	# 0.18	0.22	731	0.79
Right							
Southbound							
Prot							
Perm							
Left	L	60	1711	0.04	0.21	361	0.17
Prot							
Perm							
Thru	TR	182	1581	# 0.12	0.21	334	0.54
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.81	0.40	24.0	1.000	216	0.50	23.8	0.0	47.8	D			
TR	0.55	0.40	20.8	1.000	715	0.50	2.6	0.0	23.3	C	30.9	C	
Westbound													
L	0.90	0.40	25.3	1.000	256	0.50	33.3	0.0	58.6	E			
TR	0.51	0.40	20.4	1.000	1351	0.50	1.3	0.0	21.6	C	30.9	C	
Northbound													
LTR	0.79	0.22	33.0	1.000	731	0.50	8.4	0.0	41.4	D	41.4	D	
Southbound													
L	0.17	0.21	29.0	1.000	361	0.50	1.0	0.0	30.0	C			
TR	0.54	0.21	31.6	1.000	334	0.50	6.2	0.0	37.8	D	35.9	D	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.194 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	36.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	8.59			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.239			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	689			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		36.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		36.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.068
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	27.0	24.0	0.00	0.0	0.0	47.8
TR	0.0	0.00	27.0	20.8	0.00	0.0	0.0	23.3
	0.0						0.0	
Westbound								
L	0.0	0.00	27.0	25.3	0.00	0.0	0.0	58.6
TR	0.0	0.00	27.0	20.4	0.00	0.0	0.0	21.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	35.0	33.0	0.00	0.0	0.0	41.4
	0.0						0.0	
Southbound								
L	0.0	0.00	35.5	29.0	0.00	0.0	0.0	30.0
TR	0.0	0.00	35.5	31.6	0.00	0.0	0.0	37.8
	0.0						0.0	
Intersection Delay			34.0	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	175	392		230	361		302			60	182	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	540	1788		640	1774		1728			1711	1581	
LnCapacity	216	715		256	709		383			361	334	
Flow Ratio	0.3	0.2		0.4	0.2		0.2			0.0	0.1	
v/c Ratio	0.81	0.55		0.90	0.51		0.79			0.17	0.54	
Grn Ratio	0.40	0.40		0.40	0.40		0.22			0.21	0.21	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	3.9	7.5		5.4	6.8		7.1			1.2	4.1	
kB	0.3	0.8		0.4	0.8		0.6			0.6	0.5	
Q2	1.2	0.9		2.2	0.8		1.8			0.1	0.6	
Q Average	5.0	8.4		7.6	7.6		9.0			1.3	4.7	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	6.2	10.3		9.2	9.3		10.9			1.7	5.8	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.5		1.5	1.5		1.4			1.6	1.5	
BOQ	7.6	12.3		11.1	11.2		13.0			2.2	7.1	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.6		1.6	1.6		1.6			1.9	1.7	
BOQ	8.5	13.5		12.2	12.3		14.2			2.5	7.9	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.8		1.8	1.8		1.8			2.4	2.0	
BOQ	9.9	15.1		13.7	13.9		15.8			3.2	9.3	
QSRatio												
98th Percentile Output:												
fB%	2.2	2.0		2.0	2.0		1.9			2.8	2.3	
BOQ	11.3	16.7		15.3	15.5		17.5			3.8	10.7	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			DefL TR			DefL TR			LTR		
Volume	60	117	280	219	385	18	243	196	86	22	518	219
Lane Width	12.0			12.0	12.0		13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				32.0	5.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	1192	2682	0.46	0.44	18.5	B	18.5	B
-----	------	------	------	------	------	---	------	---

Westbound

DefL	328	738	0.74	0.44	33.8	C		
TR	814	1832	0.55	0.44	20.9	C	25.4	C

Northbound

DefL	315	1811	0.89	0.44	62.6	E		
TR	808	1819	0.40	0.44	18.4	B	38.9	D

Southbound

LTR	947	2663	0.89	0.36	39.7	D	39.7	D
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 31.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	60	117	280	219	385	18	243	196	86	22	518	219
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	35	83	61	107	5	70	56	25	6	144	61
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR		DefL	TR		DefL	TR			LTR	
Lane Width		12.0		12.0	12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		543		243	448		279	324			843	
%InSharedLn												
Prop LTs		0.131		1.000	0.000		1.000	0.000			0.028	
Prop RTs		0.613			0.045			0.306			0.288	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0		0	0		0	0			0	
%InProtPhase							0.0					
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0	0.0			0.0	
Arriv. Type		3		3	3		3	3			3	
Unit Ext.		3.0		3.0	3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0		2.0	2.0		2.0	2.0			2.0	
Ext of g		2.0		2.0	2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						32.0	5.0
Yellow		3.0						3.0	3.0
All Red		2.0						0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	60	117	280	219	385	18	243	196	86	22	518	219
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	71	139	333	243	428	20	279	225	99	24	576	243
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			DefL TR			DefL TR			LTR		
Adj flow	543			243 448			279 324			843		
Prop LTs	0.131			1.000 0.000			1.000 0.000			0.028		
Prop RTs	0.613			0.045			0.306			0.288		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LTR		DefL TR		DefL TR		LTR	
So	1900		1900 1900		1900 1900		1900	
Lanes 0	2	0	0	2	0	0	2	0
fW	1.000		1.000 1.000		1.033 1.033		0.917	
fHV	0.980		0.971 0.971		0.971 0.971		0.893	
fG	1.000		1.000 1.000		1.000 1.000		1.000	
fP	1.000		1.000 1.000		1.000 1.000		1.000	
fBB	1.000		1.000 1.000		1.000 1.000		1.000	
fA	1.000		1.000 1.000		1.000 1.000		1.000	
fLU	0.952		1.000 1.000		1.000 1.000		0.952	
fRT	0.908		0.993		0.954		0.957	
fLT	0.833		0.400 1.000		0.950 1.000		0.940	
Sec.					0.180			
fLpb	1.000		1.000 1.000		1.000 1.000		1.000	
fRpb	1.000		1.000		1.000		1.000	
S	2682		738 1832		1811 1819		2663	
Sec.					343			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	543	2682	0.20	0.44	1192	0.46
Right							
Westbound							
Prot							
Perm							
Left	DefL	243	738	# 0.33	0.44	328	0.74
Prot							
Perm							
Thru	TR	448	1832	0.24	0.44	814	0.55
Right							
Northbound							
Prot		165	1811	0.09	0.111	201	0.82
Perm		114	343	# 0.33	0.333	114	1.00
Left	DefL	279			0.44	315	0.89
Prot							
Perm							
Thru	TR	324	1819	# 0.18	0.44	808	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	843	2663	0.32	0.36	947	0.89
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.84
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.01

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.46	0.44	17.4	1.000	1192	0.50	1.1	0.0	18.5	B	18.5	B
Westbound												
DefL	0.74	0.44	20.7	1.000	328	0.50	13.1	0.0	33.8	C		
TR	0.55	0.44	18.4	1.000	814	0.50	2.5	0.0	20.9	C	25.4	C
Northbound												
DefL	0.89	0.44	34.1	1.000	315	0.50	28.5	0.0	62.6	E		
TR	0.40	0.44	16.9	1.000	808	0.50	1.5	0.0	18.4	B	38.9	D
Southbound												
LTR	0.89	0.36	27.3	1.000	947	0.50	12.3	0.0	39.7	D	39.7	D

Intersection delay = 31.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		40.0	40.0	
Effective permitted green time for LT lane group, g(s)		40.0	30.0	
Opposing effective green time, go (s)		40.0	32.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		2	2	
Adjusted LT flow rate, VLT (veh/h)		243	279	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.13	0.03	
Adjusted opposing flow rate, Vo (veh/h)		543	843	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/3600		6.08	6.98	
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.13	11.07	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56	0.64	
gq, (see Exhibit C16-4,5,6,7,8)		4.41	13.92	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		35.59	16.08	
n=Max(gq-gf)/2,0)		2.21	6.96	
PTHo=1-PLTo		0.87	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		2.22	2.98	
EL2=Max((1-Ptho*n)/Plto, 1.0)		2.03	6.40	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10	0.13	
gdifff=max(gq-gf,0)		4.41	13.92	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.40	0.18	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.400	0.180	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0			32.0
Effective permitted green time for LT lane group, g(s)	40.0			32.0
Opposing effective green time, go (s)	40.0			40.0
Number of lanes in LT lane group, N	2			2

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	71	24
Proportion of LT in LT lane group, PLT	0.131	0.000 0.000 0.028
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	448	324
Lost time for LT lane group, tL	5.00	3.00
Computation		
LT volume per cycle, LTC=VLTC/3600	1.78	0.60
Opposing lane util. factor, fLUo	1.000	0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.60	4.05
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	5.6	14.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	2.11	1.95
gu=g-gq if gq>=gf, or = g-gf if gq<gf	34.43	17.64
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.34	0.06
EL1 (refer to Exhibit C16-3)	2.18	1.93
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07
gdif=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.76	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.833	0.940

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		32.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	2.11	4.41		1.95
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.053	0.110		0.061
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	448	543		324
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.131	1.000		0.028
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	40.0	40.0	40.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.613	0.045	0.306
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v			279	
v/c ratio from Capacity Worksheet, X			0.89	
Protected phase effective green interval, g (s)			10.0	
Opposing queue effective green interval, gq			13.92	
Unopposed green interval, gu			16.08	
Red time $r=(C-g-gq-gu)$			50.0	
Arrival rate, $qa=v/(3600(\max[X,1.0]))$			0.08	
Protected ph. departure rate, $Sp=s/3600$			0.503	
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$			0.18	
XPerm			2.17	
XProt				
Case			5	
Queue at beginning of green arrow, Qa			3.34	
Queue at beginning of unsaturated green, Qu			4.95	
Residual queue, Qr			0.00	
Uniform Delay, d1			34.1	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	17.4	0.00	0.0	0.0	18.5
	0.0						0.0	
Westbound								
DefL	0.0	0.00	25.0	20.7	0.00	0.0	0.0	33.8
TR	0.0	0.00	25.0	18.4	0.00	0.0	0.0	20.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00		34.1	0.00	0.0	0.0	62.6
TR	0.0	0.00	25.0	16.9	0.00	0.0	0.0	18.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	29.0	27.3	0.00	0.0	0.0	39.7
	0.0						0.0	
Intersection Delay			31.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup		LTR	DefL	TR	DefL	TR		LTR
Init Queue		0.0	0.0	0.0	0.0	0.0		0.0
Flow Rate		285	243	448	279	324		442
So		1900	1900	1900	1900	1900		1900
No.Lanes	0	2	0	2	0	2	0	2
SL		1408	738	1832	710	1819		1398
LnCapacity		626	328	814	315	808		497
Flow Ratio		0.2	0.3	0.2	0.4	0.2		0.3
v/c Ratio		0.46	0.74	0.55	0.89	0.40		0.89
Grn Ratio		0.44	0.44	0.44	0.44	0.44		0.36
I Factor		0.889		0.932		1.000		1.000
AT or PVG		3	3	3	3	3		3
Pltn Ratio		1.00	1.00	1.00	1.00	1.00		1.00
PF2		1.00	1.00	1.00	1.00	1.00		1.00
Q1		5.0	5.0	8.2	4.3	5.5		10.4
kB		0.7	0.5	0.9	0.5	1.0		0.7
Q2		0.6	1.2	1.1	2.5	0.7		3.7
Q Average		5.6	6.3	9.3	6.8	6.1		14.1
Q Spacing		25.0	25.0	25.0	25.0	25.0		25.0
Q Storage		0	0	0	0	0		0
Q S Ratio								
70th Percentile Output:								
fB%		1.2	1.2	1.2	1.2	1.2		1.2
BOQ		6.9	7.7	11.4	8.4	7.5		17.0
QSRatio								
85th Percentile Output:								
fB%		1.5	1.5	1.4	1.5	1.5		1.4
BOQ		8.3	9.3	13.5	10.1	9.1		20.0
QSRatio								
90th Percentile Output:								
fB%		1.7	1.6	1.6	1.6	1.6		1.5
BOQ		9.3	10.3	14.7	11.1	10.1		21.5
QSRatio								
95th Percentile Output:								
fB%		1.9	1.9	1.8	1.9	1.9		1.7
BOQ		10.7	11.8	16.4	12.7	11.6		23.4
QSRatio								
98th Percentile Output:								
fB%		2.2	2.1	1.9	2.1	2.1		1.8
BOQ		12.2	13.4	18.0	14.2	13.1		25.2
QSRatio								

ERROR MESSAGES

WARNING: Phase 6 < minimum green time for peds.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/28/2013	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Period	Year : 2015 FULL Mitigated Action
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	658	393	3	1	413	621	0	0	1	105	0	130
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

		Signal Operations								
Phase	Combination	1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X	X			Peds			
WB	Left		P	P		SB	Left	P		
	Thru		P	P			Thru	P		
	Right	P	P	P			Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right	P		
Green		35.0	13.0	12.0				14.0		
Yellow		3.0	3.0	3.0				3.0		
All Red		0.0	0.0	2.0				2.0		

Intersection Performance Summary								
Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	745	1711	0.97	0.57	42.5	D		
TR	923	1628	0.47	0.57	12.8	B	31.3	C
Westbound								
LT	573	1844	0.79	0.31	34.6	C	14.1	B
R	1568	1568	0.43	1.00	0.5	A		
Northbound								
LTR	287	1844	0.01	0.16	32.2	C	32.2	C
Southbound								
L	204	1313	0.53	0.16	44.5	D		
LT	280	1801	0.00	0.16	32.1	C	24.4	C
R	887	1478	0.15	0.60	8.3	A		
Intersection Delay = 23.0 (sec/veh) Intersection LOS = C								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 FULL Mitigated Action
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume	658	393	3		1	413	621		0	0	1		105	0	130
% Heavy Veh	2	2	2		3	3	3		0	0	1		2	2	2
PHF	0.91	0.91	0.91		0.91	0.91	0.91		0.25	0.25	0.25		0.97	0.97	0.97
PK 15 Vol	181	108	1		1	113	171		0	0	1		27	0	34
Hi Ln Vol															
% Grade		0				0				0				0	
Ideal Sat	1900	1900				1900	1900			1900			1900	1900	1900
ParkExist			X												
NumPark			5												
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
LGConfig	L	TR				LT	R			LTR			L	LT	R
Lane Width	11.0	12.0				12.0	12.0			16.0			10.0	11.0	10.0
RTOR Vol			0				0				0				0
Adj Flow	723	435				455	682			4			108	0	134
%InSharedLn													0		
Prop LTS	1.000	0.000				0.002				0.000			1.000	0.000	
Prop RTS		0.007				0.000	1.000			1.000				0.000	1.000
Peds Bikes	0	0	0		0				0				0		
Buses	0	0				0	0			0			0	0	0
%InProtPhase					0.0										
Duration	0.25														
Area Type: All other areas															

OPERATING PARAMETERS

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Init Unmet	0.0	0.0			0.0	0.0			0.0				0.0	0.0	0.0
Arriv. Type	3	3			3	3			3				3	3	3
Unit Ext.	3.0	3.0			3.0	3.0			3.0				3.0	3.0	3.0
I Factor		0.735				0.546				1.000				1.000	
Lost Time	2.0	2.0			2.0	2.0			2.0				2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0			2.0				2.0	2.0	2.0
Ped Min g		14.6				24.6				20.9				20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X	X			Peds		
WB	Left		P	P		SB	Left	P	
	Thru		P	P			Thru	P	
	Right	P	P	P			Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		35.0	13.0	12.0			14.0		
Yellow		3.0	3.0	3.0			3.0		
All Red		0.0	0.0	2.0			2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	658	393	3		1	413	621		0	0	1		105	0	130
PHF	0.91	0.91	0.91		0.91	0.91	0.91		0.25	0.25	0.25		0.97	0.97	0.97
Adj flow	723	432	3		1	454	682		0	0	4		108	0	134
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	723	435				455	682			4			108	0	134
Prop LTs	1.000	0.000				0.002				0.000			1.000	0.000	
Prop RTs		0.007				0.000	1.000			1.000				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.980	0.980			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.999			1.000	0.850			0.865					1.000	0.850
fLT	0.950	1.000			1.000				1.000				0.755	1.000	
Sec.	0.250				0.999										
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1711	1628			1844	1568			1844				1313	1801	1478
Sec.	450				1843										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		665	1711	# 0.39	0.389	665	1.00
Perm		58	450	# 0.13	0.178	80	0.73
Left	L	723			0.57	745	0.97
Prot							
Perm							
Thru	TR	435	1628	0.27	0.57	923	0.47
Right							
Westbound							
Prot							
Perm							
Left							
Prot		348	1844	# 0.19	0.189	348	1.00
Perm		225	1843	0.12	0.122	225	1.00
Thru	LT	455			0.31	573	0.79
Right	R	682	1568	0.43	1.00	1568	0.43
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.16	287	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	108	1313	# 0.08	0.16	204	0.53
Prot							
Perm							
Thru	LT	0	1801	0.00	0.16	280	0.00
Right	R	134	1478	0.09	0.60	887	0.15

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.79
Total lost time per cycle, L = 13.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.92

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.97	0.57	20.5	1.000	745	0.50	22.0	0.0	42.5	D		
TR	0.47	0.57	11.5	1.000	923	0.50	1.3	0.0	12.8	B	31.3	C
Westbound												
LT	0.79	0.31	28.4	1.000	573	0.50	6.2	0.0	34.6	C	14.1	B
R	0.43	1.00	0.0	0.950	1568	0.50	0.5	0.0	0.5	A		
Northbound												
LTR	0.01	0.16	32.2	1.000	287	0.50	0.1	0.0	32.2	C	32.2	C
Southbound												
L	0.53	0.16	35.0	1.000	204	0.50	9.5	0.0	44.5	D		
LT	0.00	0.16	32.1	1.000	280	0.50	0.0	0.0	32.1	C	24.4	C

R 0.15 0.60 7.9 1.000 887 0.50 0.4 0.0 8.3 A

Intersection delay = 23.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	51.0			14.0
Effective permitted green time for LT lane group, g(s)	16.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	723			108
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	455			4
Lost time for LT lane group, tL	3.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.08			2.70
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.38			0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	16.00			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.00			14.00
n=Max(gq-gf)/2,0)	8.00			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.00			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.94			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.25			0.29
gdiff=max(gq-gf,0)	16.00			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.250			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		11.0	14.0	14.0
Opposing effective green time, go (s)		51.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	435	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.00	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.88	0.00	0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	7.2	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.43	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	3.79	14.00	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	0.00
EL1 (refer to Exhibit C16-3)	2.16	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.18	0.14	0.14
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.999	1.000	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		435		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	51.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	51.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.007
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	723			
v/c ratio from Capacity Worksheet, X	0.97			
Protected phase effective green interval, g (s)	35.0			
Opposing queue effective green interval, gq	12.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	39.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.50			
XPerm	1.61			
XProt	0.89			
Case	3			
Queue at beginning of green arrow, Qa	9.05			
Queue at beginning of unsaturated green, Qu	2.41			
Residual queue, Qr	1.21			
Uniform Delay, d1	20.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		20.5	0.00	0.0	0.0	42.5
TR	0.0	0.00	19.5	11.5	0.00	0.0	0.0	12.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	28.4	0.00	0.0	0.0	34.6
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.2	0.00	0.0	0.0	32.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	35.0	0.00	0.0	0.0	44.5
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	18.0	7.9	0.00	0.0	0.0	8.3

Intersection Delay	23.0	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	723	435		455	682	4		108	0	134
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1315	1628		1843	1568	1844		1313	1801	1478
LnCapacity	745	923		573	1568	287		204	280	887
Flow Ratio	0.5	0.3		0.2	0.4	0.0		0.1	0.0	0.1
v/c Ratio	0.97	0.47		0.79	0.43	0.01		0.53	0.00	0.15
Grn Ratio	0.57	0.57		0.31	1.00	0.16		0.16	0.16	0.60
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	12.6	6.4		9.2		0.1		2.5	0.0	1.5
kB	0.7	0.8		0.4	0.9	0.5		0.4	0.5	1.1
Q2	6.6	0.7		1.5	0.7	0.0		0.4	0.0	0.2
Q Average	19.2	7.1		10.7		0.1		2.9	0.0	1.7
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2		1.3		1.3	1.3	1.3
BOQ	23.1	8.7		13.0		0.1		3.6	0.0	2.1
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4		1.7		1.6	1.7	1.6
BOQ	27.0	10.5		15.4		0.2		4.5	0.0	2.7
QSRatio										
90th Percentile Output:										
fB%	1.5	1.6		1.6		2.0		1.8	2.0	1.9
BOQ	29.0	11.5		16.7		0.2		5.2	0.0	3.1
QSRatio										
95th Percentile Output:										
fB%	1.6	1.8		1.7		2.6		2.2	2.6	2.3
BOQ	31.1	13.1		18.4		0.2		6.3	0.0	3.8
QSRatio										
98th Percentile Output:										
fB%	1.7	2.1		1.9		3.2		2.5	3.2	2.8
BOQ	33.2	14.7		20.1		0.3		7.4	0.0	4.6
QSRatio										

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 3 < minimum green time for peds.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/8/13	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2015 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	461	36	0	2	62	69	4	3	0	62	6	969
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds	X		
WB	Left	P				SB	Left	P		
	Thru	P					Thru	P		
	Right	P					Right	P		
	Peds	X					Peds	X		
NB	Right					EB	Right			
SB	Right		P			WB	Right			
Green		37.0	5.0					35.0		
Yellow		3.0	3.0					3.0		
All Red		0.0	2.0					2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	774	2006	0.66	0.50	21.6	C		
TR	1056	2111	0.04	0.50	11.5	B	20.9	C

DefL	518	1331	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	541	1390	0.14	0.39	18.3	B	41.8	D
R	762	1524	0.96	0.50	44.2	D		

Intersection Delay = 31.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

--- OPERATIONAL ANALYSIS ---

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/8/13
Analysis Time Period: Weekday 12-1 PM MD Peak Hour
Intersection: Boscombe Ave & Tyrellan Ave
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2015 Miti-Action Conditions
Project ID: Charleston EIS
E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

--- VOLUME DATA ---

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	461	36	0	2	62	69	4	3	0	62	6	969
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	127	10	0	1	17	19	2	1	0	17	2	269
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	507	40			127		7	5			76	732
%InSharedLn												
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908	
Prop RTs		0.000			0.449			0.000			0.000	1.000
Peds Bikes	0		0	0		0	0		0	0		0
Buses	0	0			0		0	0			0	0
%InProtPhase	0.0											0.0
Duration	0.25			Area Type: All other areas								

--- OPERATING PARAMETERS ---

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X		X				Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right			P			WB	Right		
Green		37.0		5.0					35.0	
Yellow		3.0		3.0					3.0	
All Red		0.0		2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	461	36	0	2	62	69	4	3	0	62	6	969
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	507	40	0	2	68	57	7	5	0	69	7	732
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	507	40			127		7	5			76	732
Prop LTs	1.000	0.000			0.016		1.000	0.000			0.908	
Prop RTs		0.000			0.449			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.933				1.000		1.000	0.850	
fLT	0.950	1.000		0.954			0.708	1.000		0.775		
Sec.	0.672											
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	2006	2111		3072			1331	1881		1390	1524	
Sec.	1418											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	0	2006	0.00	0.111	223	0.00
Perm		507	1418	# 0.36	0.389	551	0.92
Left		507			0.50	774	0.66
Prot	TR	40	2111	0.02	0.50	1056	0.04
Perm							
Thru							
Right	LTR	127	3072	0.04	0.41	1263	0.10
Prot							
Perm							
Left	DefL	7	1331	0.01	0.39	518	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Prot							
Perm							
Thru	LT	76	1390	0.05	0.39	541	0.14
Prot							
Perm							
Left	R	732	1524	# 0.48	0.50	762	0.96
Prot							
Perm							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.84
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.66	0.50	17.5	1.000	774	0.50	4.1	0.0	21.6	C			
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	20.9	C	
Westbound													
LTR	0.10	0.41	16.3	1.000	1263	0.50	0.2	0.0	16.4	B	16.4	B	
Northbound													
DefL	0.01	0.39	16.9	1.000	518	0.50	0.0	0.0	16.9	B			
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.14	0.39	17.8	1.000	541	0.50	0.5	0.0	18.3	B	41.8	D	

R 0.96 0.50 21.6 1.000 762 0.50 22.5 0.0 44.2 D

Intersection delay = 31.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	35.0		35.0	
Opposing effective green time, go (s)	37.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	507		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	127		76	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	12.68		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.67		1.90	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	35.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.41	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.11		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.672		0.708	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		37.0		35.0
Effective permitted green time for LT lane group, g(s)		37.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	69
Proportion of LT in LT lane group, PLT	0.000	0.016 0.000 0.908
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	40	5
Lost time for LT lane group, tL	3.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.73
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	30.4	4.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.62	30.50
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.78
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.775

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	37.0	37.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	127	40	76	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.016	1.000	0.908
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	37.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	37.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.449	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	507			
v/c ratio from Capacity Worksheet, X	0.66			
Protected phase effective green interval, g (s)	10.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	35.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.14			
Protected ph. departure rate, Sp=s/3600	0.557			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.39			
XPerm	0.82			
XProt				
Case	4			
Queue at beginning of green arrow, Qa	0.00			
Queue at beginning of unsaturated green, Qu	6.34			
Residual queue, Qr	0.00			
Uniform Delay, d1	17.5			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00		17.5	0.00	0.0	0.0	21.6
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	16.3	0.00	0.0	0.0	16.4
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	22.5	21.6	0.00	0.0	0.0	44.2
Intersection Delay			31.8	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound			
LaneGroup	DefL	TR			LTR			DefL	TR			LT	R			
Init Queue	0.0	0.0			0.0			0.0	0.0			0.0	0.0			
Flow Rate	507	40			66			7	5			76	732			
So	1900	1900			1900			1900	1900			1900	1900			
No.Lanes	0	2	0	0	2	0		0	2	0	0	1	1			
SL	1549	2111			1613			1331	1881			1390	1524			
LnCapacity	774	1056			663			518	732			541	762			
Flow Ratio	0.3	0.0			0.0			0.0	0.0			0.1	0.5			
v/c Ratio	0.66	0.04			0.10			0.01	0.01			0.14	0.96			
Grn Ratio	0.50	0.50			0.41			0.39	0.39			0.39	0.50			
I Factor		0.962			1.000				1.000			0.889				
AT or PVG	3	3			3			3	3			3	3			
Pltn Ratio	1.00	1.00			1.00			1.00	1.00			1.00	1.00			
PF2	1.00	1.00			1.00			1.00	1.00			1.00	1.00			
Q1	6.8	0.5			1.0			0.1	0.1			1.2	17.6			
kB	0.9	1.1			0.9			0.7	0.9			0.7	0.8			
Q2	1.7	0.0			0.1			0.0	0.0			0.1	7.1			
Q Average	8.5	0.6			1.1			0.1	0.1			1.3	24.7			
Q Spacing	25.0	25.0			25.0			25.0	25.0			25.0	25.0			
Q Storage	0	0			0			0	0			0	0			
Q S Ratio																
70th Percentile Output:																
fB%	1.2	1.3			1.3			1.3	1.3			1.3	1.2			
BOQ	10.4	0.7			1.4			0.2	0.1			1.7	29.7			
QSRatio																
85th Percentile Output:																
fB%	1.5	1.7			1.6			1.7	1.7			1.6	1.4			
BOQ	12.4	0.9			1.8			0.2	0.1			2.2	34.6			
QSRatio																
90th Percentile Output:																
fB%	1.6	1.9			1.9			2.0	2.0			1.9	1.5			
BOQ	13.5	1.1			2.1			0.2	0.2			2.5	37.1			
QSRatio																
95th Percentile Output:																
fB%	1.8	2.5			2.4			2.6	2.6			2.4	1.6			
BOQ	15.1	1.4			2.7			0.3	0.2			3.2	39.7			
QSRatio																
98th Percentile Output:																
fB%	2.0	3.0			2.9			3.2	3.2			2.8	1.7			
BOQ	16.8	1.7			3.2			0.4	0.3			3.8	42.2			
QSRatio																

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	10	2	333	20	268	4	136	315	210	236	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0					27.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	664	1732	0.02	0.38	11.6	B	11.6	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	488	1273	0.88	0.38	36.1	D	30.2	C
R	481	1256	0.68	0.38	22.5	C		

Northbound

LTR	799	1776	0.61	0.45	15.7	B	15.7	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	507	1127	1.02	0.45	62.6	E	62.6	E
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 35.5 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	10	2	333	20	268	4	136	315	210	236	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	102	6	82	1	37	85	61	69	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		14			430	327		489			519	
%InSharedLn												
Prop LTs		0.071			0.944			0.008			0.470	
Prop RTs		0.143			0.000	1.000		0.693			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0						27.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	10	2	333	20	268	4	136	315	210	236	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	11	2	406	24	327	4	146	339	244	274	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	14			430 327			489			519		
Prop LTs	0.071			0.944			0.008			0.470		
Prop RTs	0.143			0.000 1.000			0.693			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.981			1.000 0.850			0.906			1.000		
fLT	0.980			0.728			0.996			0.565		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1732			1273 1256			1776			1127		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	14	1732	0.01	0.38	664	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	430	1273	# 0.34	0.38	488	0.88
Right	R	327	1256	0.26	0.38	481	0.68
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	489	1776	0.28	0.45	799	0.61
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	519	1127	# 0.46	0.45	507	1.02
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.80
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.96

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.38	11.5	1.000	664	0.50	0.1	0.0	11.6	B	11.6	B	
Westbound													
LT	0.88	0.38	17.2	1.000	488	0.50	18.9	0.0	36.1	D	30.2	C	
R	0.68	0.38	15.4	1.000	481	0.50	7.1	0.0	22.5	C			
Northbound													
LTR	0.61	0.45	12.5	1.000	799	0.50	3.2	0.0	15.7	B	15.7	B	
Southbound													
LTR	1.02	0.45	16.5	1.000	507	0.50	46.1	0.0	62.6	E	62.6	E	

Intersection delay = 35.5 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	23.0	23.0	27.0	27.0
Effective permitted green time for LT lane group, g(s)	23.0	23.0	27.0	27.0
Opposing effective green time, go (s)	23.0	23.0	27.0	27.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	406	4	244
Proportion of LT in LT lane group, PLT	0.071	0.944	0.008	0.470
Proportion of LT in opposing flow, PLTo	0.94	0.07	0.47	0.01
Adjusted opposing flow rate, Vo (veh/h)	430	14	519	489
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	6.77	0.07	4.07
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.17	0.23	8.65	8.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.9	0.0	18.1	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.62	0.62	0.55	0.55
gq, (see Exhibit C16-4,5,6,7,8)	8.27	0.00	8.57	7.97
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.05	23.00	8.91	19.03
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	3.98
PTHo=1-PLTo	0.06	0.93	0.53	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07	0.94	0.01	0.47
EL1 (refer to Exhibit C16-3)	2.14	1.40	2.34	2.27
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	3.93
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.17	0.07	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00	7.97
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.56
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.980	0.728	0.996	0.565

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	23.0		27.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.27		8.57	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.360		0.317	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	430		519	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.071		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0		27.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	23.0		27.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	18.5	17.2	0.00	0.0	0.0	36.1
R	0.0	0.00	18.5	15.4	0.00	0.0	0.0	22.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	16.5	12.5	0.00	0.0	0.0	15.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	16.5	16.5	0.00	3.0	0.0	62.6
	0.0						0.0	
Intersection Delay			35.5	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	14			430	327	489			519			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1732			1273	1256	1776			1127			
LnCapacity	664			488	481	799			507			
Flow Ratio	0.0			0.3	0.3	0.3			0.5			
v/c Ratio	0.02			0.88	0.68	0.61			1.02			
Grn Ratio	0.38			0.38	0.38	0.45			0.45			
I Factor	1.000			0.933		0.919			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.1			6.7	4.5	6.2			8.6			
kB	0.6			0.5	0.5	0.7			0.5			
Q2	0.0			2.6	1.0	1.0			6.7			
Q Average	0.2			9.3	5.5	7.2			15.3			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			11.3	6.8	8.8			18.5			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.4	1.5	1.5			1.4			
BOQ	0.3			13.5	8.3	10.6			21.7			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.7	1.6			1.5			
BOQ	0.3			14.7	9.2	11.7			23.4			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.8	1.9	1.8			1.6			
BOQ	0.4			16.3	10.7	13.3			25.3			
QSRatio												
98th Percentile Output:												
fB%	3.2			1.9	2.2	2.1			1.8			
BOQ	0.5			18.0	12.1	14.8			27.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/8/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 Miti-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				130		149	543	101		124	698	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
	Capacity		v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 398 1493 0.83 0.27 37.5 D 37.5 D

Northbound

TR 1096 1935 0.63 0.57 11.0 B 11.0 B

Southbound

L 290 511 0.50 0.57 8.5 A
 T 941 1660 0.86 0.57 12.4 B 11.8 B

Intersection Delay = 15.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				130		149	543	101		124	698	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				39		44	146	27		36	203	
Hi Ln Vol												
% Grade				0			0			0		
Ideal Sat				1900			1900			1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width				12.0			15.0			10.0	10.0	
RTOR Vol						0			0			
Adj Flow				332			693			144	812	
%InSharedLn												
Prop LTS					0.467			0.000		1.000	0.000	
Prop RTS				0.533			0.157			0.000		
Peds Bikes	0			0	0		0	0				
Buses				0			4			0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				130		149	543	101		124	698	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				155		177	584	109		144	812	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					332			693		144	812	
Prop LTs					0.467			0.000		1.000	0.000	
Prop RTs					0.533			0.157			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound			Northbound			Southbound		
LG					LR			TR			L T		
So					1900			1900			1900 1900		
Lanes	0	0	0	0	0	0	0	1	0		1	1	0
fW					1.000			1.100			0.933 0.933		
fHV					0.990			0.962			0.943 0.943		
fG					1.000			1.000			1.000 1.000		
fP					0.875			1.000			1.000 1.000		
fBB					1.000			0.984			1.000 0.992		
fA					1.000			1.000			1.000 1.000		
fLU					1.000			1.000			1.000 1.000		
fRT					0.928			0.979			1.000		
fLT					0.977			1.000			0.305 1.000		
Sec.													
fLpb					1.000			1.000			1.000 1.000		
fRpb					1.000			1.000			1.000		
S					1493			1935			511 1660		
Sec.													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	332	1493	# 0.22	0.27	398	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	693	1935	0.36	0.57	1096	0.63
Right							
Southbound							
Prot							
Perm							
Left	L	144	511	0.28	0.57	290	0.50
Prot							
Perm							
Thru	T	812	1660	# 0.49	0.57	941	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS

Eastbound

Westbound

LR0.830.2720.71.0003980.5016.70.037.5D37.5D

Northbound

TR0.630.578.81.00010960.502.20.011.0B11.0B

Southbound

L0.500.577.81.0002900.500.70.08.5A
T0.860.5711.01.0009410.501.30.012.4B11.8B

Intersection delay = 15.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				144
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				693
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.40
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				11.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				8.13
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.87
n=Max(gq-gf)/2,0)				4.07
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.49
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.31
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.305

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.467 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.13
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.239
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				693
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	16.0		34.0	
Vbicg	0	0		

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.533	0.157
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.7	0.00	0.0	0.0	37.5
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.8	0.00	0.0	0.0	11.0
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	7.8	0.00	0.0	0.0	8.5
T	0.0	0.00	13.0	11.0	0.00	0.0	0.0	12.4
	0.0						0.0	

Intersection Delay	15.8	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					332		693	144	812
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1493		1935	511	1660
LnCapacity					398		1096	290	941
Flow Ratio					0.2		0.4	0.3	0.5
v/c Ratio					0.83		0.63	0.50	0.86
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.901		0.798		0.114
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					5.2		7.8	1.4	11.5
kB					0.4		0.7	0.0	0.1
Q2					1.7		1.2	0.0	0.6
Q Average					6.9		9.0	1.5	12.0
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					8.5		11.0	1.9	14.6
QSRatio									
85th Percentile Output:									
fB%					1.5		1.4	1.6	1.4
BOQ					10.2		13.1	2.4	17.2
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.9	1.5
BOQ					11.2		14.3	2.8	18.6
QSRatio									
95th Percentile Output:									
fB%					1.9		1.8	2.3	1.7
BOQ					12.8		15.9	3.5	20.4
QSRatio									
98th Percentile Output:									
fB%					2.1		1.9	2.8	1.8
BOQ					14.4		17.6	4.2	22.1
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2015 Miti-Action Conditions
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	158	247	195	239	486	44	107	177	141	46	61	104
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left		P	
	Thru	P				Thru		P	
	Right	P				Right		P	
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		35.0					20.0	20.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	231	595	0.78	0.39	40.6	D		
TR	690	1775	0.65	0.39	25.9	C	30.1	C
Westbound								
L	278	696	0.96	0.40	68.9	E		
TR	1340	3349	0.47	0.40	21.1	C	35.2	D
Northbound								
LTR	749	3370	0.57	0.22	34.4	C	34.4	C
Southbound								
L	384	1728	0.16	0.22	29.1	C		
TR	357	1607	0.52	0.22	35.8	D	34.1	C

Intersection Delay = 33.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	158	247	195	239	486	44	107	177	141	46	61	104
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	45	70	55	66	148	13	29	48	38	15	20	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	180	451		266	633			430		61	184	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.267			0.000	
Prop RTs		0.377			0.063			0.291			0.565	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		35.0						20.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	158	247	195	239	486	44	107	177	141	46	61	104
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	180	281	170	266	593	40	115	190	125	61	80	104
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	180	451		266	633		430			61	184	
Prop LTs	1.000	0.000		1.000	0.000		0.267			0.000		
Prop RTs	0.377			0.063			0.291			0.565		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.943			0.991		0.956				0.915	
fLT	0.327	1.000		0.409	1.000		0.987			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	595	1775		696	3349		3370			1728	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	180	595	0.30	0.39	231	0.78
Prot							
Perm							
Thru	TR	451	1775	0.25	0.39	690	0.65
Right							
Westbound							
Prot							
Perm							
Left	L	266	696	# 0.38	0.40	278	0.96
Prot							
Perm							
Thru	TR	633	3349	0.19	0.40	1340	0.47
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	430	3370	# 0.13	0.22	749	0.57
Right							
Southbound							
Prot							
Perm							
Left	L	61	1728	0.04	0.22	384	0.16
Prot							
Perm							
Thru	TR	184	1607	# 0.11	0.22	357	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.78	0.39	24.1	1.000	231	0.50	16.5	0.0	40.6	D			
TR	0.65	0.39	22.5	1.000	690	0.50	3.4	0.0	25.9	C	30.1	C	
Westbound													
L	0.96	0.40	26.2	1.000	278	0.50	42.6	0.0	68.9	E			
TR	0.47	0.40	20.0	1.000	1340	0.50	1.1	0.0	21.1	C	35.2	D	
Northbound													
LTR	0.57	0.22	31.2	1.000	749	0.50	3.2	0.0	34.4	C	34.4	C	
Southbound													
L	0.16	0.22	28.2	1.000	384	0.50	0.9	0.0	29.1	C			
TR	0.52	0.22	30.7	1.000	357	0.50	5.1	0.0	35.8	D	34.1	C	

Intersection delay = 33.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0		
Effective permitted green time for LT lane group, g(s)	35.0	36.0		
Opposing effective green time, go (s)	36.0	35.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	180	266		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	633	451		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.50	6.65		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.31	11.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.60	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	7.23	14.39		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	27.77	21.61		
n=Max(gq-gf)/2,0)	3.62	7.19		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.43	1.99		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.11	0.11		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.33	0.30		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.327	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.267 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	35.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.23			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.207			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	633			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		35.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		36.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.063
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	27.5	24.1	0.00	0.0	0.0	40.6
TR	0.0	0.00	27.5	22.5	0.00	0.0	0.0	25.9
	0.0						0.0	
Westbound								
L	0.0	0.00	27.0	26.2	0.00	0.0	0.0	68.9
TR	0.0	0.00	27.0	20.0	0.00	0.0	0.0	21.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	35.0	31.2	0.00	0.0	0.0	34.4
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	28.2	0.00	0.0	0.0	29.1
TR	0.0	0.00	35.0	30.7	0.00	0.0	0.0	35.8
	0.0						0.0	
Intersection Delay			33.5	sec/veh	Intersection LOS C			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	180	451		266	332		225			61	184	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	595	1775		696	1758		1769			1728	1607	
LnCapacity	231	690		278	703		393			384	357	
Flow Ratio	0.3	0.3		0.4	0.2		0.1			0.0	0.1	
v/c Ratio	0.78	0.65		0.96	0.47		0.57			0.16	0.52	
Grn Ratio	0.39	0.39		0.40	0.40		0.22			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	3.9	9.2		6.5	6.1		5.0			1.2	4.0	
kB	0.3	0.6		0.4	0.8		0.6			0.6	0.5	
Q2	0.9	1.1		3.2	0.7		0.8			0.1	0.6	
Q Average	4.8	10.4		9.6	6.9		5.8			1.3	4.6	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	6.0	12.6		11.7	8.4		7.1			1.7	5.7	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.5		1.5			1.6	1.5	
BOQ	7.3	14.9		13.9	10.2		8.6			2.2	7.0	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.6		1.6	1.6		1.7			1.9	1.7	
BOQ	8.2	16.2		15.1	11.2		9.6			2.5	7.8	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.7		1.7	1.9		1.9			2.4	2.0	
BOQ	9.6	17.9		16.8	12.8		11.1			3.2	9.2	
QSRatio												
98th Percentile Output:												
fB%	2.3	1.9		1.9	2.1		2.2			2.8	2.3	
BOQ	11.0	19.6		18.5	14.3		12.6			3.8	10.6	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2015 Miti-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			DefL TR			DefL TR			LTR		
Volume	51	131	227	232	437	9	219	142	121	21	523	120
Lane Width	12.0			12.0	12.0		13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0					31.0	6.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	1199	2697	0.39	0.44	17.6	B	17.6	B
-----	------	------	------	------	------	---	------	---

Westbound

DefL	373	840	0.76	0.44	33.6	C		
TR	825	1857	0.66	0.44	23.5	C	26.9	C

Northbound

DefL	381	1847	0.62	0.44	36.1	D		
TR	804	1810	0.35	0.44	17.7	B	26.0	C

Southbound

LTR	1025	2975	0.69	0.34	29.1	C	29.1	C
-----	------	------	------	------	------	---	------	---

Intersection Delay = 25.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	51	131	227	232	437	9	219	142	121	21	523	120
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	14	37	64	71	133	3	59	38	33	6	139	32
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR		DefL	TR		DefL	TR			LTR	
Lane Width		12.0		12.0	12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		465		283	544		235	283			706	
%InSharedLn												
Prop LTs		0.125		1.000	0.000		1.000	0.000			0.031	
Prop RTs		0.555			0.020			0.459			0.181	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0		0	0		0	0			0	
%InProtPhase							0.0					
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0	0.0			0.0	
Arriv. Type		3		3	3		3	3			3	
Unit Ext.		3.0		3.0	3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0		2.0	2.0		2.0	2.0			2.0	
Ext of g		2.0		2.0	2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds	X	X
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		40.0						31.0	6.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						0.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	51	131	227	232	437	9	219	142	121	21	523	120
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	58	149	258	283	533	11	235	153	130	22	556	128
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			DefL TR			DefL TR			LTR		
Adj flow	465			283 544			235 283			706		
Prop LTs	0.125			1.000 0.000			1.000 0.000			0.031		
Prop RTs	0.555			0.020			0.459			0.181		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound		Westbound		Northbound		Southbound	
LG	LTR		DefL TR		DefL TR		LTR	
So	1900		1900 1900		1900 1900		1900	
Lanes 0	2	0	0	2	0	0	2	0
fW	1.000		1.000 1.000		1.033 1.033		0.917	
fHV	0.980		0.980 0.980		0.990 0.990		0.980	
fG	1.000		1.000 1.000		1.000 1.000		1.000	
fP	1.000		1.000 1.000		1.000 1.000		1.000	
fBB	1.000		1.000 1.000		1.000 1.000		1.000	
fA	1.000		1.000 1.000		1.000 1.000		1.000	
fLU	0.952		1.000 1.000		1.000 1.000		0.952	
fRT	0.917		0.997		0.931		0.973	
fLT	0.829		0.451 1.000		0.950 1.000		0.941	
Sec.					0.247			
fLpb	1.000		1.000 1.000		1.000 1.000		1.000	
fRpb	1.000		1.000		1.000		1.000	
S	2697		840 1857		1847 1810		2975	
Sec.					481			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	465	2697	0.17	0.44	1199	0.39
Right							
Westbound							
Prot							
Perm							
Left	DefL	283	840	# 0.34	0.44	373	0.76
Prot							
Perm							
Thru	TR	544	1857	0.29	0.44	825	0.66
Right							
Northbound							
Prot		80	1847	0.04	0.122	226	0.35
Perm		155	481	# 0.32	0.322	155	1.00
Left	DefL	235			0.44	381	0.62
Prot							
Perm							
Thru	TR	283	1810	# 0.16	0.44	804	0.35
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	706	2975	0.24	0.34	1025	0.69
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.82
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.39	0.44	16.8	1.000	1199	0.50	0.8	0.0	17.6	B	17.6	B
Westbound												
DefL	0.76	0.44	21.0	1.000	373	0.50	12.6	0.0	33.6	C		
TR	0.66	0.44	19.6	1.000	825	0.50	3.8	0.0	23.5	C	26.9	C
Northbound												
DefL	0.62	0.44	28.8	1.000	381	0.50	7.3	0.0	36.1	D		
TR	0.35	0.44	16.5	1.000	804	0.50	1.2	0.0	17.7	B	26.0	C
Southbound												
LTR	0.69	0.34	25.4	1.000	1025	0.50	3.8	0.0	29.1	C	29.1	C

Intersection delay = 25.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)		40.0	40.0	
Effective permitted green time for LT lane group, g(s)		40.0	29.0	
Opposing effective green time, go (s)		40.0	31.0	
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	2		
Adjusted LT flow rate, VLT (veh/h)	283	235		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.12	0.03		
Adjusted opposing flow rate, Vo (veh/h)	465	706		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C		7.08	5.88	
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		6.11	9.27	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56	0.66	
gq, (see Exhibit C16-4,5,6,7,8)		2.85	10.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		37.15	18.69	
n=Max(gq-gf)/2,0)		1.42	5.15	
PTHo=1-PLTo		0.88	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		2.06	2.61	
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.39	4.83	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10	0.14	
gdifff=max(gq-gf,0)		2.85	10.31	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.45	0.25	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.451	0.247	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
	sec			
Total actual green time for LT lane group, G (s)	40.0			31.0
Effective permitted green time for LT lane group, g(s)	40.0			31.0
Opposing effective green time, go (s)	40.0			40.0
Number of lanes in LT lane group, N	2			2

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	58	22
Proportion of LT in LT lane group, PLT	0.125	0.000 0.000 0.031
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	544	283
Lost time for LT lane group, tL	5.00	3.00
Computation		
LT volume per cycle, LTC=VLTC/3600	1.45	0.55
Opposing lane util. factor, fLUo	1.000	0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.80	3.54
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	7.6	14.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	3.90	1.27
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.35	16.55
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.32	0.07
EL1 (refer to Exhibit C16-3)	2.40	1.85
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.07
gdif=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.829	0.941

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0		31.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	3.90	2.85		1.27
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.098	0.071		0.041
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	544	465		283
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.125	1.000		0.031
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	40.0	40.0	40.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.555	0.020	0.459
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v			235	
v/c ratio from Capacity Worksheet, X			0.62	
Protected phase effective green interval, g (s)			11.0	
Opposing queue effective green interval, gq			10.31	
Unopposed green interval, gu			18.69	
Red time $r=(C-g-gq-gu)$			50.0	
Arrival rate, $qa=v/(3600(\max[X,1.0]))$			0.07	
Protected ph. departure rate, $Sp=s/3600$			0.513	
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$			0.21	
XPerm			1.33	
XProt				
Case			5	
Queue at beginning of green arrow, Qa			1.28	
Queue at beginning of unsaturated green, Qu			3.94	
Residual queue, Qr			0.00	
Uniform Delay, d1			28.8	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	16.8	0.00	0.0	0.0 0.0 0.0	17.6
Westbound								
DefL	0.0	0.00	25.0	21.0	0.00	0.0	0.0	33.6
TR	0.0 0.0	0.00	25.0	19.6	0.00	0.0	0.0 0.0	23.5
Northbound								
DefL	0.0	0.00		28.8	0.00	0.0	0.0	36.1
TR	0.0 0.0	0.00	25.0	16.5	0.00	0.0	0.0 0.0	17.7
Southbound								
LTR	0.0 0.0 0.0	0.00	29.5	25.4	0.00	0.0	0.0 0.0 0.0	29.1
Intersection Delay			25.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		DefL	TR	DefL	TR	LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	
Flow Rate	244		283	544	235	283	370	
So	1900		1900	1900	1900	1900	1900	
No.Lanes	0	2	0	2	0	2	0	2
SL	1416		840	1857	857	1810	1562	
LnCapacity	629		373	825	381	804	538	
Flow Ratio	0.2		0.3	0.3	0.3	0.2	0.2	
v/c Ratio	0.39		0.76	0.66	0.62	0.35	0.69	
Grn Ratio	0.44		0.44	0.44	0.44	0.44	0.34	
I Factor	0.884		0.927		1.000		1.000	
AT or PVG	3		3	3	3	3	3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	
PF2	1.00		1.00	1.00	1.00	1.00	1.00	
Q1	4.1		5.9	10.7	3.5	4.7	7.9	
kB	0.7		0.5	0.9	0.6	1.0	0.7	
Q2	0.5		1.5	1.7	0.9	0.5	1.5	
Q Average	4.6		7.4	12.4	4.4	5.2	9.5	
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	
Q Storage	0		0	0	0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2	1.2	1.2	
BOQ	5.6		9.1	15.0	5.5	6.4	11.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5	1.4	1.5	1.5	1.4	
BOQ	6.9		10.9	17.7	6.7	7.8	13.7	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.6	1.5	1.7	1.7	1.6	
BOQ	7.7		12.0	19.1	7.5	8.7	14.9	
QSRatio								
95th Percentile Output:								
fB%	2.0		1.8	1.7	2.0	2.0	1.8	
BOQ	9.1		13.5	20.9	8.9	10.1	16.6	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.0	1.8	2.3	2.2	1.9	
BOQ	10.5		15.1	22.6	10.3	11.6	18.2	
QSRatio								

ERROR MESSAGES

WARNING: Phase 6 < minimum green time for peds.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/28/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Period	Year : 2015 FULL Mitigated Action
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	723	349	4	3	356	625	2	3	2	124	0	275
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		31.0	30.0					14.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34	34
35	35	35	35	35	35	35	35	35
36	36	36	36	36	36	36	36	36
37	37	37	37	37	37	37	37	37
38	38	38	38	38	38	38	38	38
39	39	39	39	39	39	39	39	39
40	40	40	40	40	40	40	40	40
41	41	41	41	41	41	41	41	41
42	42	42	42	42	42	42	42	42
43	43	43	43	43	43	43	43	43
44	44	44	44	44	44	44	44	44
45	45	45	45	45	45	45	45	45
46	46	46	46	46	46	46	46	46
47	47	47	47	47	47	47	47	47
48	48	48	48	48	48	48	48	48
49	49	49	49	49	49	49	49	49
50	50	50	50	50	50	50	50	50
51	51	51	51	51</				

L	802	1728	1.00	0.73	43.5	D		
TR	1206	1644	0.33	0.73	4.7	A	30.8	C

LT	626	1877	0.60	0.33	27.8	C	10.5	B
R	1599	1599	0.41	1.00	0.5	A		

LTR	148	952	0.11	0.16	34.2	C	34.2	C
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L	204	1310	0.71	0.16	54.6	D		
LT	283	1818	0.00	0.16	32.1	C	25.3	C
R	829	1492	0.41	0.56	13.1	B		

Intersection Delay = 22.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 FULL Mitigated Action
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	723	349	4	3	356	625	2	3	2	124	0	275
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.86	0.80	0.80
PK 15 Vol	201	97	1	1	94	164	1	2	1	36	0	86
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	803	392			378	658		17		144	0	344
%InSharedLn										0		
Prop LTS	1.000	0.000			0.008			0.294		1.000	0.000	
Prop RTS		0.010			0.000	1.000		0.294			0.000	1.000
Peds Bikes		0	0		0			0			0	
Buses	0	0			0	0		0		0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.687			0.650			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		31.0	30.0				14.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	723	349	4		3	356	625		2	3	2		124	0	275
PHF	0.90	0.90	0.90		0.95	0.95	0.95		0.44	0.44	0.44		0.86	0.80	0.80
Adj flow	803	388	4		3	375	658		5	7	5		144	0	344
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	803	392				378	658			17			144	0	344
Prop LTs	1.000	0.000				0.008				0.294			1.000	0.000	
Prop RTs		0.010				0.000	1.000			0.294				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.990	0.990			0.990				0.990	0.990	0.990
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.998			1.000	0.850			0.960					1.000	0.850
fLT	0.950	1.000			0.998				0.465				0.746	1.000	
Sec.	0.292														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1644			1877	1599			952				1310	1818	1492
Sec.	532														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		595	1728	# 0.34	0.344	595	1.00
Perm		208	532	# 0.39	0.389	207	1.00
Left	L	803			0.73	802	1.00
Prot							
Perm							
Thru	TR	392	1644	0.24	0.73	1206	0.33
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	378	1877	0.20	0.33	626	0.60
Right	R	658	1599	0.41	1.00	1599	0.41
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	144	1310	# 0.11	0.16	204	0.71
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	344	1492	0.23	0.56	829	0.41

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.85
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.95

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.00	0.73	16.9	1.000	802	0.50	26.6	0.0	43.5	D		
TR	0.33	0.73	4.2	1.000	1206	0.50	0.5	0.0	4.7	A	30.8	C
Westbound												
LT	0.60	0.33	25.0	1.000	626	0.50	2.8	0.0	27.8	C	10.5	B
R	0.41	1.00	0.0	0.950	1599	0.50	0.5	0.0	0.5	A		
Northbound												
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C
Southbound												
L	0.71	0.16	36.0	1.000	204	0.50	18.6	0.0	54.6	D		
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	25.3	C

R 0.41 0.56 11.6 1.000 829 0.50 1.5 0.0 13.1 B

Intersection delay = 22.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	35.0			14.0
Opposing effective green time, go (s)	30.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	803			144
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	378			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.08			3.60
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.45			0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67			0.84
gq, (see Exhibit C16-4,5,6,7,8)	15.95			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.05			14.00
n=Max(gq-gf)/2,0)	7.97			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.86			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.76			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11			0.29
gdifff=max(gq-gf,0)	15.95			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.29			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.292			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		30.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		30.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.008	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	392	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.80	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.1	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.86	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.06	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.07	0.18	0.14
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.998	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		392		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.008		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	66.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	66.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.010
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	803			
v/c ratio from Capacity Worksheet, X	1.00			
Protected phase effective green interval, g (s)	31.0			
Opposing queue effective green interval, gq	15.95			
Unopposed green interval, gu	19.05			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.27			
XPerm	1.51			
XProt	0.82			
Case	3			
Queue at beginning of green arrow, Qa	7.97			
Queue at beginning of unsaturated green, Qu	3.55			
Residual queue, Qr	2.62			
Uniform Delay, d1	16.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		16.9	0.00	0.3	0.0	43.5
TR	0.0	0.00	12.0	4.2	0.00	0.0	0.0	4.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	30.0	25.0	0.00	0.0	0.0	27.8
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	36.0	0.00	0.0	0.0	54.6
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	20.0	11.6	0.00	0.0	0.0	13.1

Intersection Delay	22.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	803	392		378	658		17	144	0	344
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1094	1644		1877	1599		952	1310	1818	1492
LnCapacity	802	1206		626	1599		148	204	283	829
Flow Ratio	0.7	0.2		0.2	0.4		0.0	0.1	0.0	0.2
v/c Ratio	1.00	0.33		0.60	0.41		0.11	0.71	0.00	0.41
Grn Ratio	0.73	0.73		0.33	1.00		0.16	0.16	0.16	0.56
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00			1.00	1.00	1.00	1.00
Q1	8.2	3.4		7.9			0.4	3.4	0.0	5.0
kB	0.7	0.9		0.5	1.0		0.3	0.4	0.5	1.0
Q2	8.3	0.4		0.8	0.7		0.0	0.8	0.0	0.7
Q Average	16.4	3.9		8.7			0.4	4.2	0.0	5.7
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2			1.3	1.2	1.3	1.2
BOQ	19.8	4.8		10.6			0.5	5.3	0.0	7.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.5			1.7	1.5	1.7	1.5
BOQ	23.2	5.9		12.6			0.7	6.5	0.0	8.5
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6			2.0	1.7	2.0	1.7
BOQ	25.0	6.7		13.8			0.8	7.2	0.0	9.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8			2.5	2.0	2.6	1.9
BOQ	26.9	8.0		15.4			1.0	8.6	0.0	10.9
QSRatio										
98th Percentile Output:										
fB%	1.8	2.4		2.0			3.1	2.3	3.2	2.2
BOQ	28.9	9.2		17.1			1.2	9.9	0.0	12.4
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/8/13	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2015 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	442	35	0	1	35	42	3	3	2	60	1	946
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		38.0						42.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	637	1509	0.77	0.42	30.6	C		
TR	900	2132	0.04	0.42	15.4	B	29.5	C

LTR	1318	3122	0.05	0.42	15.5	B	15.5	B
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LTR	1469	3147	0.01	0.47	12.9	B	12.9	B
-----	------	------	------	------	------	---	------	---

LT	666	1427	0.10	0.47	13.7	B	40.5	D
R	739	1583	0.94	0.47	43.0	D		

Intersection Delay = 34.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	442	35	0	1	35	42	3	3	2	60	1	946
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	123	10	0	1	9	11	2	2	1	16	1	252
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	491	39			72			16			65	694
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.952		1.000			1.000			0.937		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3		17.5			20.3			20.3		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		38.0						42.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	442	35	0	1	35	42	3	3	2	60	1	946
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	491	39	0	1	37	34	6	6	4	64	1	694
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	491	39			72			16			65	694
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.472			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.708	1.000			0.954			0.913		0.766	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1509	2132			3122			3147		1427	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	491	1509	# 0.33	0.42	637	0.77
Prot							
Perm							
Thru	TR	39	2132	0.02	0.42	900	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	72	3122	0.02	0.42	1318	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3147	0.01	0.47	1469	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	65	1427	0.05	0.47	666	0.10
Right	R	694	1583	# 0.44	0.47	739	0.94

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.76$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.86$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.77	0.42	22.3	1.000	637	0.50	8.4	0.0	30.6	C		
TR	0.04	0.42	15.3	1.000	900	0.50	0.1	0.0	15.4	B	29.5	C
Westbound												
LTR	0.05	0.42	15.4	1.000	1318	0.50	0.1	0.0	15.5	B	15.5	B
Northbound												
LTR	0.01	0.47	12.9	1.000	1469	0.50	0.0	0.0	12.9	B	12.9	B
Southbound												
LT	0.10	0.47	13.4	1.000	666	0.50	0.3	0.0	13.7	B	40.5	D

R 0.94 0.47 22.8 1.000 739 0.50 20.2 0.0 43.0 D

Intersection delay = 34.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	38.0			
Effective permitted green time for LT lane group, g(s)	38.0			
Opposing effective green time, go (s)	38.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	491			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	72			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	12.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.95			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.58			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	38.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.41			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.11			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.708			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		38.0	42.0	42.0
Effective permitted green time for LT lane group, g(s)		38.0	42.0	42.0
Opposing effective green time, go (s)		38.0	42.0	42.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	1	6	64
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375
Proportion of LT in opposing flow, PLTo	0.00	0.98	0.38
Adjusted opposing flow rate, Vo (veh/h)	39	65	16
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.60
Opposing lane util. factor, fLUo	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.49	1.63	0.21
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	30.7	28.5	7.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.53	0.53
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.31	13.51	34.79
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.02	0.63
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.98
EL1 (refer to Exhibit C16-3)	1.43	1.47	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.08	0.09
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.92	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.954	0.913	0.766

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	38.0	38.0	42.0	42.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	72	39	65	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	38.0	38.0	42.0	42.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	38.0	38.0	42.0	42.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.472	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	26.0	22.3	0.00	0.0	0.0	30.6
TR	0.0	0.00	26.0	15.3	0.00	0.0	0.0	15.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	26.0	15.4	0.00	0.0	0.0	15.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	24.0	12.9	0.00	0.0	0.0	12.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	24.0	13.4	0.00	0.0	0.0	13.7
R	0.0	0.00	24.0	22.8	0.00	0.0	0.0	43.0
Intersection Delay			34.7	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	491	39			37				8				65	694	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1509	2132			1639				1652				1427	1583	
LnCapacity	637	900			692				771				666	739	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.4	
v/c Ratio	0.77	0.04			0.05				0.01				0.10	0.94	
Grn Ratio	0.42	0.42			0.42				0.47				0.47	0.47	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	10.5	0.6			0.5				0.1				0.9	16.5	
kB	0.8	1.0			0.9				1.0				0.8	0.9	
Q2	2.4	0.0			0.0				0.0				0.1	6.3	
Q Average	12.9	0.6			0.6				0.1				1.0	22.8	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	15.5	0.8			0.8				0.2				1.3	27.3	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	18.3	1.0			1.0				0.2				1.6	32.0	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	19.8	1.2			1.2				0.2				1.9	34.3	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.4	1.6	
BOQ	21.6	1.5			1.5				0.3				2.4	36.7	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			3.0				3.2				2.9	1.7	
BOQ	23.4	1.9			1.8				0.4				2.9	39.1	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		145	266	450	266	83	198		479	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	16.0				21.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	38.8	D
R	220	1652	0.70	0.13	39.2	D		
Westbound								
LTR	1250	4689	0.89	0.27	26.5	C	26.5	C
Northbound								
L	126	360	0.71	0.35	44.3	D		
T	647	1848	0.33	0.35	15.6	B	24.1	C
Southbound								
TR	703	2010	0.79	0.35	25.3	C	25.3	C

Intersection Delay = 26.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		145	266	450	266	83	198		479	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		38	76	128	76	23	54		138	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		153		1115		90	215			557	
%InSharedLn												
Prop LTs					0.271		1.000	0.000			0.000	
Prop RTs			1.000		0.271			0.000			0.011	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	16.0					21.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		145	266	450	266	83	198		479	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		153	302	511	302	90	215		551	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		153		1115		90	215		557		
Prop LTs					0.271		1.000	0.000		0.000		
Prop RTs			1.000		0.271			0.000		0.011		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.990		0.980	0.980	0.962	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.972	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.959			1.000	0.999	
fLT	0.950		0.987		0.193	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4689		360	1848	2010	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	153	1652	# 0.09	0.13	220	0.70
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1115	4689	# 0.24	0.27	1250	0.89
Right							
Northbound							
Prot							
Perm							
Left	L	90	360	0.25	0.35	126	0.71
Prot							
Perm							
Thru	T	215	1848	0.12	0.35	647	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	557	2010	# 0.28	0.35	703	0.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	38.8	D	
R	0.70	0.13	24.8	1.000	220	0.50	14.3	0.0	39.2	D			
Westbound													
LTR	0.89	0.27	21.2	1.000	1250	0.50	5.4	0.0	26.5	C	26.5	C	
Northbound													
L	0.71	0.35	16.9	1.000	126	0.50	27.4	0.0	44.3	D	24.1	C	
T	0.33	0.35	14.3	1.000	647	0.50	1.3	0.0	15.6	B			
Southbound													
TR	0.79	0.35	17.5	1.000	703	0.50	7.8	0.0	25.3	C	25.3	C	

Intersection delay = 26.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			21.0	
Effective permitted green time for LT lane group, g(s)			21.0	
Opposing effective green time, go (s)			21.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			90	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			557	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.50	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.28	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.65	
gq, (see Exhibit C16-4,5,6,7,8)			12.10	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			8.90	
n=Max(gq-gf)/2,0)			6.05	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.20	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.19	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.19	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.193	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.271 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			21.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			12.10	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.576	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			557	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0			21.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	16.0			21.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.271	0.011
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				60.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	24.8	0.00	0.0	0.0	39.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.0	21.2	0.00	0.0	0.0	26.5
	0.0						0.0	
Northbound								
L	0.0	0.00	19.5	16.9	0.00	0.0	0.0	44.3
T	0.0	0.00	19.5	14.3	0.00	0.0	0.0	15.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	19.5	17.5	0.00	0.0	0.0	25.3
	0.0						0.0	
Intersection Delay			26.8	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	153		409		90	215		557
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1721		360	1848		2010
LnCapacity	222	220		458		126	647		703
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.3
v/c Ratio	0.02	0.70		0.89		0.71	0.33		0.79
Grn Ratio	0.13	0.13		0.27		0.35	0.35		0.35
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	2.4		6.6		1.3	2.6		8.3
kB	0.3	0.3		0.2		0.2	0.6		0.6
Q2	0.0	0.5		1.6		0.4	0.3		2.0
Q Average	0.1	3.0		8.2		1.7	2.9		10.3
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	3.7		10.0		2.2	3.7		12.5
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.4
BOQ	0.1	4.7		12.0		2.8	4.6		14.9
QSRatio									
90th Percentile Output:									
fB%	2.0	1.8		1.6		1.9	1.8		1.6
BOQ	0.1	5.3		13.1		3.2	5.2		16.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.2		1.8		2.3	2.2		1.7
BOQ	0.2	6.4		14.7		4.0	6.3		17.9
QSRatio									
98th Percentile Output:									
fB%	3.2	2.5		2.0		2.8	2.5		1.9
BOQ	0.2	7.5		16.3		4.8	7.4		19.6
QSRatio									

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 08/16/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	9	5	382	26	389	5	162	388	196	204	0
Lane Width	15.5			11.0 10.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	22.0				28.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 637 1738 0.02 0.37 12.2 B 12.2 B

Westbound

LT 481 1312 0.92 0.37 40.8 D 39.0 D
 R 474 1293 0.89 0.37 37.0 D

Northbound

LTR 832 1782 0.73 0.47 17.8 B 17.8 B

Southbound

LTR 474 1016 0.93 0.47 41.5 D 41.5 D

Intersection Delay = 32.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/16/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	9	5	382	26	389	5	162	388	196	204	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	104	7	106	2	45	107	54	56	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width	15.5			11.0	10.0		15.0			16.0		
RTOR Vol			0			0			0			0
Adj Flow	15			443	423		609			439		
%InSharedLn												
Prop LTS		0.000			0.937			0.008			0.490	
Prop RTS	0.333			0.000	1.000		0.700			0.000		
Peds Bikes	0			0	0		0			0	0	
Buses	0			0	0		2			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000			0.849			0.861			1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	11.5			13.5			15.2			12.1		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		22.0						28.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	9	5	382	26	389	5	162	388	196	204	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	10	5	415	28	423	5	178	426	215	224	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	15			443 423			609			439		
Prop LTs	0.000			0.937			0.008			0.490		
Prop RTs	0.333			0.000 1.000			0.700			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.955			1.000 0.850			0.906			1.000		
fLT	1.000			0.729			0.997			0.490		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1738			1312 1293			1782			1016		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	15	1738	0.01	0.37	637	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	443	1312	# 0.34	0.37	481	0.92
Right	R	423	1293	0.33	0.37	474	0.89
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	609	1782	0.34	0.47	832	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	439	1016	# 0.43	0.47	474	0.93
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.77
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.92

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.37	12.1	1.000	637	0.50	0.1	0.0	12.2	B	12.2	B	
Westbound													
LT	0.92	0.37	18.2	1.000	481	0.50	22.6	0.0	40.8	D	39.0	D	
R	0.89	0.37	17.9	1.000	474	0.50	19.2	0.0	37.0	D			
Northbound													
LTR	0.73	0.47	13.0	1.000	832	0.50	4.9	0.0	17.8	B	17.8	B	
Southbound													
LTR	0.93	0.47	15.0	1.000	474	0.50	26.5	0.0	41.5	D	41.5	D	

Intersection delay = 32.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	22.0	22.0	28.0	28.0
Effective permitted green time for LT lane group, g(s)	22.0	22.0	28.0	28.0
Opposing effective green time, go (s)	22.0	22.0	28.0	28.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	415	5	215
Proportion of LT in LT lane group, PLT	0.000	0.937	0.008	0.490
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.49	0.01
Adjusted opposing flow rate, Vo (veh/h)	443	15	439	609
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	6.92	0.08	3.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.38	0.25	7.32	10.15
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.63	0.53	0.53
gq, (see Exhibit C16-4,5,6,7,8)	8.97	0.00	6.56	9.83
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.03	22.00	9.62	18.17
n=Max(gq-gf)/2,0)	4.48	0.00	0.00	4.92
PTHo=1-PLTo	0.06	1.00	0.51	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.49
EL1 (refer to Exhibit C16-3)	2.17	1.40	2.16	2.56
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07		1.00	4.84
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.18	0.07	0.11
gdifff=max(gq-gf,0)	8.97	0.00	0.00	9.83
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.59	0.73	1.00	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.729	0.997	0.490

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	22.0		28.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.97		6.56	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.408		0.234	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	443		439	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.008	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	22.0		28.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	22.0		28.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	19.0	12.1	0.00	0.0	0.0	12.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	19.0	18.2	0.00	0.0	0.0	40.8
R	0.0	0.00	19.0	17.9	0.00	0.0	0.0	37.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	16.0	13.0	0.00	0.0	0.0	17.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	16.0	15.0	0.00	0.0	0.0	41.5
	0.0						0.0	

Intersection Delay	32.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	15			443	423	609		439	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1738			1312	1293	1782		1016	
LnCapacity	637			481	474	832		474	
Flow Ratio	0.0			0.3	0.3	0.3		0.4	
v/c Ratio	0.02			0.92	0.89	0.73		0.93	
Grn Ratio	0.37			0.37	0.37	0.47		0.47	
I Factor	1.000			0.849		0.861		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.2			7.1	6.6	8.2		6.9	
kB	0.6			0.4	0.4	0.7		0.5	
Q2	0.0			3.1	2.6	1.7		3.5	
Q Average	0.2			10.2	9.2	9.9		10.4	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.2			12.3	11.2	12.0		12.6	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.4	1.4	1.4		1.4	
BOQ	0.3			14.6	13.3	14.3		15.0	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.6	1.6	1.6		1.6	
BOQ	0.3			15.9	14.5	15.5		16.3	
QSRatio									
95th Percentile Output:									
fB%	2.6			1.7	1.8	1.7		1.7	
BOQ	0.4			17.6	16.2	17.2		18.0	
QSRatio									
98th Percentile Output:									
fB%	3.1			1.9	1.9	1.9		1.9	
BOQ	0.6			19.3	17.8	18.9		19.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				104		197	593	90		138	689	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 393 1475 0.86 0.27 41.0 D 41.0 D

Northbound

TR 1131 1996 0.66 0.57 11.5 B 11.5 B

Southbound

L 276 487 0.55 0.57 10.3 B
 T 977 1725 0.77 0.57 11.7 B 11.5 B

Intersection Delay = 16.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				104		197	593	90		138	689	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				29		55	163	25		38	189	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					338			751		152	757	
%InSharedLn												
Prop LTs					0.346			0.000		1.000	0.000	
Prop RTs					0.654			0.132		0.000		
Peds Bikes	0			0		0	0		0			
Buses					0			2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.940			0.789				0.272	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				104		197	593	90		138	689	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				117		221	652	99		152	757	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					338			751		152	757	
Prop LTs					0.346			0.000		1.000	0.000	
Prop RTs					0.654			0.132			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.990			0.980			0.980	0.980	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.992			1.000	0.992	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.912			0.982				1.000	
fLT				0.983			1.000			0.280	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1475			1996			487	1725	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	338	1475	# 0.23	0.27	393	0.86
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	751	1996	0.38	0.57	1131	0.66
Right							
Southbound							
Prot							
Perm							
Left	L	152	487	0.31	0.57	276	0.55
Prot							
Perm							
Thru	T	757	1725	# 0.44	0.57	977	0.77
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.80

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.86	0.27	20.9	1.000	393	0.50	20.1	0.0	41.0	D	41.0	D
Northbound												
TR	0.66	0.57	9.0	1.000	1131	0.50	2.4	0.0	11.5	B	11.5	B
Southbound												
L	0.55	0.57	8.2	1.000	276	0.50	2.2	0.0	10.3	B		
T	0.77	0.57	10.0	1.000	977	0.50	1.7	0.0	11.7	B	11.5	B

Intersection delay = 16.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				152
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				751
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				2.53
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				12.52
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				8.96
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.04
n=Max(gq-gf)/2,0)				4.48
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.28
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.280

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.346 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.96
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.264
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				751
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.654	0.132
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.9	0.00	0.0	0.0	41.0
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.0	0.00	0.0	0.0	11.5
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	8.2	0.00	0.0	0.0	10.3
T	0.0	0.00	13.0	10.0	0.00	0.0	0.0	11.7
	0.0						0.0	

Intersection Delay	16.5	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					338		751	152	757
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1475		1996	487	1725
LnCapacity					393		1131	276	977
Flow Ratio					0.2		0.4	0.3	0.4
v/c Ratio					0.86		0.66	0.55	0.77
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.940		0.789		0.272
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					5.4		8.7	1.6	9.7
kB					0.4		0.7	0.1	0.2
Q2					2.0		1.4	0.1	0.8
Q Average					7.4		10.1	1.7	10.5
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					9.0		12.3	2.2	12.7
QSRatio									
85th Percentile Output:									
fB%					1.5		1.4	1.6	1.4
BOQ					10.8		14.6	2.8	15.1
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.9	1.6
BOQ					11.9		15.8	3.2	16.4
QSRatio									
95th Percentile Output:									
fB%					1.8		1.7	2.3	1.7
BOQ					13.5		17.5	4.0	18.1
QSRatio									
98th Percentile Output:									
fB%					2.0		1.9	2.8	1.9
BOQ					15.0		19.2	4.7	19.8
QSRatio									

ERROR MESSAGES

No errors to report.

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/28/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	173	296	209	263	609	48	150	314	212	45	121	156
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P	P	
Thru	P	P			Thru	P	P	
Right	P	P			Right	P	P	
Peds					Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	6.0	32.0			11.0	23.0		
Yellow	3.0	3.0			3.0	3.0		
All Red	2.0	2.0			0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	245	1728	0.76	0.48	30.7	C		
TR	851	1782	0.58	0.48	18.9	B	22.2	C
Westbound								
L	304	828	0.90	0.37	56.3	E		
TR	1277	3482	0.65	0.37	26.0	C	33.5	C
Northbound								
LTR	977	3432	0.77	0.41	28.7	C	28.7	C
Southbound								
L	170	667	0.32	0.26	31.3	C		
TR	411	1607	0.80	0.26	44.6	D	42.8	D

Intersection Delay = 30.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	173	296	209	263	609	48	150	314	212	45	121	156
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	80	56	68	195	15	42	87	59	13	36	46
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	186	491		274	828			752		54	330	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.222		1.000	0.000	
Prop RTS		0.352			0.057			0.314			0.564	
Peds Bikes	0			0		0		0		0		
Buses	0	0		0	0			0		0	0	
%InProtPhase	0.0						0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0			0.0		0.0	0.0	
Arriv. Type	3	3		3	3			3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0			3.0		3.0	3.0	
I Factor		0.700			0.903			1.000			0.855	
Lost Time	2.0	2.0		2.0	2.0			2.0		2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0			2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	P
	Thru	P		P				Thru	P	P
	Right	P		P				Right	P	P
	Peds							Peds		
WB	Left			P			SB	Left		P
	Thru			P				Thru		P
	Right			P				Right		P
	Peds			X				Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		6.0		32.0					11.0	23.0
Yellow		3.0		3.0					3.0	3.0
All Red		2.0		2.0					0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	173	296	209	263	609	48	150	314	212	45	121	156
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	186	318	173	274	781	47	167	349	236	54	144	186
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	186	491		274	828		752			54	330	
Prop LTs	1.000	0.000		1.000	0.000		0.222			1.000	0.000	
Prop RTs	0.352			0.057			0.314			0.564		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	2	0		1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.947			0.991		0.953				0.915	
fLT	0.950	1.000		0.446	1.000		0.989			0.367	1.000	
Sec.	0.173						0.588					
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	1728	1782		828	3482		3432			667	1607	
Sec.	315						2039					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		115	1728	# 0.07	0.067	115	1.00
Perm		71	315	0.23	0.411	130	0.55
Left	L	186			0.48	245	0.76
Prot							
Perm							
Thru	TR	491	1782	0.28	0.48	851	0.58
Right							
Westbound							
Prot							
Perm							
Left	L	274	828	# 0.33	0.37	304	0.90
Prot							
Perm							
Thru	TR	828	3482	0.24	0.37	1277	0.65
Right							
Northbound							
Prot							
Perm							
Left							
Prot		343	3432	# 0.10	0.100	343	1.00
Perm		409	2039	0.20	0.311	634	0.65
Thru	LTR	752			0.41	977	0.77
Right							
Southbound							
Prot							
Perm							
Left	L	54	667	0.08	0.26	170	0.32
Prot							
Perm							
Thru	TR	330	1607	# 0.21	0.26	411	0.80
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70

Total lost time per cycle, L = 19.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.89

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.76	0.48	16.4	1.000	245	0.50	14.3	0.0	30.7	C		
TR	0.58	0.48	16.9	1.000	851	0.50	2.0	0.0	18.9	B	22.2	C
Westbound												
L	0.90	0.37	27.0	1.000	304	0.50	29.4	0.0	56.3	E		
TR	0.65	0.37	23.7	1.000	1277	0.50	2.3	0.0	26.0	C	33.5	C
Northbound												
LTR	0.77	0.41	22.8	1.000	977	0.50	5.8	0.0	28.7	C	28.7	C
Southbound												
L	0.32	0.26	27.1	1.000	170	0.50	4.2	0.0	31.3	C		
TR	0.80	0.26	31.4	1.000	411	0.50	13.3	0.0	44.6	D	42.8	D

Intersection delay = 30.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	43.0	32.0		23.0
Effective permitted green time for LT lane group, g(s)	37.0	33.0		23.0
Opposing effective green time, go (s)	33.0	43.0		37.0
Number of lanes in LT lane group, N	1	1		1
Number of lanes in opposing approach, No	2	1		2
Adjusted LT flow rate, VLT (veh/h)	186	274		54
Proportion of LT in LT lane group, PLT	1.000	1.000		1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00		0.22
Adjusted opposing flow rate, Vo (veh/h)	828	491		752
Lost time for LT lane group, tL	5.00	4.00		5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	4.65	6.85		1.35
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.87	12.27		9.87
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.52		0.59
gq, (see Exhibit C16-4,5,6,7,8)	18.16	2.63		0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.84	30.37		23.00
n=Max(gq-gf)/2,0)	9.08	1.31		0.00
PTHo=1-PLTo	1.00	1.00		0.78
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		1.00
EL1 (refer to Exhibit C16-3)	2.94	2.07		2.73
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.12		0.17
gdifff=max(gq-gf,0)	0.00	0.00		0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.45		0.37
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.173	0.446		0.367

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			37.0	
Effective permitted green time for LT lane group, g(s)			28.0	
Opposing effective green time, go (s)			23.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	167
Proportion of LT in LT lane group, PLT	0.000 0.000 0.222 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	330
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	4.18
Opposing lane util. factor, fLUo	0.952 1.000 1.000 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.25
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.74
gq, (see Exhibit C16-4,5,6,7,8)	15.04
gu=g-gq if gq>=gf, or = g-gf if gq<gf	12.96
n=Max(gq-gf)/2,0)	7.52
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.79
EL1 (refer to Exhibit C16-3)	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.27
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.588

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	32.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	18.16			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.567			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	828			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	32.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	33.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.057
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v	186			
v/c ratio from Capacity Worksheet, X	0.76			
Protected phase effective green interval, g (s)	6.0			
Opposing queue effective green interval, gq	18.16			
Unopposed green interval, gu	18.84			
Red time r=(C-g-gq-gu)	47.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.17			
XPerm	0.59			
XProt	0.95			
Case	1			
Queue at beginning of green arrow, Qa	2.43			
Queue at beginning of unsaturated green, Qu	0.94			
Residual queue, Qr	0.00			
Uniform Delay, d1	16.4			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		16.4	0.00	0.0	0.0	30.7
TR	0.0	0.00	23.5	16.9	0.00	0.0	0.0	18.9
	0.0						0.0	
Westbound								
L	0.0	0.00	28.5	27.0	0.00	0.0	0.0	56.3
TR	0.0	0.00	28.5	23.7	0.00	0.0	0.0	26.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	22.8	0.00	0.0	0.0	28.7
	0.0						0.0	
Southbound								
L	0.0	0.00	33.5	27.1	0.00	0.0	0.0	31.3
TR	0.0	0.00	33.5	31.4	0.00	0.0	0.0	44.6
	0.0						0.0	

Intersection Delay	30.9	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	186	491		274	434		394			54	330	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	512	1782		828	1828		1248			667	1607	
LnCapacity	245	851		304	670		513			170	411	
Flow Ratio	0.4	0.3		0.3	0.2		0.3			0.1	0.2	
v/c Ratio	0.76	0.58		0.90	0.65		0.77			0.32	0.80	
Grn Ratio	0.48	0.48		0.37	0.37		0.41			0.26	0.26	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.6	8.8		6.5	9.0		6.3			1.1	7.7	
kB	0.3	0.7		0.4	0.8		0.7			0.3	0.5	
Q2	0.8	1.0		2.5	1.4		2.1			0.1	1.8	
Q Average	3.4	9.8		8.9	10.4		8.4			1.2	9.5	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.2	
BOQ	4.3	11.9		10.9	12.6		10.2			1.6	11.6	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.5	1.4		1.5			1.6	1.4	
BOQ	5.3	14.1		13.0	14.9		12.2			2.0	13.8	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.6	1.6		1.6			1.9	1.6	
BOQ	6.0	15.4		14.2	16.2		13.3			2.3	15.0	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.7		1.8	1.7		1.8			2.4	1.7	
BOQ	7.2	17.1		15.8	17.9		15.0			2.9	16.7	
QSRatio												
98th Percentile Output:												
fB%	2.5	1.9		2.0	1.9		2.0			2.9	1.9	
BOQ	8.4	18.7		17.5	19.6		16.6			3.5	18.3	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	79	147	286	229	512	24	255	262	112	25	815	162
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	38.0				34.0	5.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	831	1969	0.67	0.42	24.5	C	24.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	953	2257	1.03	0.42	60.9	E	60.9	E
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	314	1992	0.86	0.47	61.3	E		
TR	867	1857	0.47	0.47	18.3	B	35.4	D

Southbound

LTR	1147	3036	0.94	0.38	42.5	D	42.5	D
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Intersection Delay = 43.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	147	286	229	512	24	255	262	112	25	815	162
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	21	40	78	73	164	8	68	72	31	7	219	44
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		557			981		271	411			1077	
%InSharedLn												
Prop LTs		0.154			0.300		1.000	0.000			0.025	
Prop RTs		0.558			0.032			0.299			0.162	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase							0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds	X	X
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		38.0							34.0	5.0
Yellow		3.0							3.0	3.0
All Red		2.0							0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	147	286	229	512	24	255	262	112	25	815	162
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	86	160	311	294	656	31	271	288	123	27	876	174
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	557			981			271 411			1077		
Prop LTs	0.154			0.300			1.000 0.000			0.025		
Prop RTs	0.558			0.032			0.299			0.162		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.916			0.995			0.955			0.976		
fLT	0.606			0.633			0.950 1.000			0.938		
Sec.							0.125					
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1969			2257			1992 1857			3036		
Sec.							262					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	557	1969	0.28	0.42	831	0.67
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	981	2257	# 0.43	0.42	953	1.03
Right							
Northbound							
Prot		178	1992	0.09	0.111	221	0.81
Perm		93	262	0.35	0.356	93	1.00
Left	DefL	271			0.47	314	0.86
Prot							
Perm				#			
Thru	TR	411	1857	# 0.22	0.47	867	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1077	3036	0.35	0.38	1147	0.94
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.01
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.21

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.67	0.42	21.0	1.000	831	0.50	3.6	0.0	24.5	C	24.5	C	
Westbound													
LTR	1.03	0.42	26.0	1.000	953	0.50	34.9	0.0	60.9	E	60.9	E	
Northbound													
DefL	0.86	0.47	35.7	1.000	314	0.50	25.5	0.0	61.3	E			
TR	0.47	0.47	16.4	1.000	867	0.50	1.9	0.0	18.3	B	35.4	D	
Southbound													
LTR	0.94	0.38	27.0	1.000	1147	0.50	15.5	0.0	42.5	D	42.5	D	

Intersection delay = 43.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			42.0	
Effective permitted green time for LT lane group, g(s)			32.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			271	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			1077	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			6.78	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			14.14	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.62	
gq, (see Exhibit C16-4,5,6,7,8)			20.66	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.34	
n=Max(gq-gf)/2,0)			10.33	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.76	
EL2=Max((1-Ptho*n)/Plto, 1.0)			9.20	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.13	
gdifff=max(gq-gf,0)			20.66	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.13	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.125	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	38.0	38.0		34.0
Effective permitted green time for LT lane group, g(s)	38.0	38.0		34.0
Opposing effective green time, go (s)	38.0	38.0		42.0
Number of lanes in LT lane group, N	2	2		2

Number of lanes in opposing approach, No	2	2	2
Adjusted LT flow rate, VLT (veh/h)	86	294	27
Proportion of LT in LT lane group, PLT	0.154	0.300	0.000
Proportion of LT in opposing flow, PLTo	0.30	0.15	0.00
Adjusted opposing flow rate, Vo (veh/h)	981	557	411
Lost time for LT lane group, tL	5.00	5.00	3.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.15	7.35	0.68
Opposing lane util. factor, fLUo	0.952	0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.88	7.31	5.14
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.3	0.0	14.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.53
gq, (see Exhibit C16-4,5,6,7,8)	15.85	5.09	3.19
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.15	32.91	19.52
n=Max(gq-gf)/2,0)	6.30	2.55	0.00
PTHo=1-PLTo	0.70	0.85	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.60	0.95	0.06
EL1 (refer to Exhibit C16-3)	3.84	2.50	2.10
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.98	2.25	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.10	0.06
gdif=max(gq-gf,0)	12.60	5.09	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.30	0.36	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.606	0.633	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	38.0	38.0		34.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	15.85	5.09		3.19
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.417	0.134		0.094
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	981	557		411
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	0.154	0.300		0.025
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	38.0	38.0	42.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	38.0	38.0	42.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.558	0.032	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v			271	
v/c ratio from Capacity Worksheet, X			0.86	
Protected phase effective green interval, g (s)			10.0	
Opposing queue effective green interval, gq			20.66	
Unopposed green interval, gu			11.34	
Red time $r=(C-g-gq-gu)$			48.0	
Arrival rate, $qa=v/(3600(\max[X,1.0]))$			0.08	
Protected ph. departure rate, $Sp=s/3600$			0.553	
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$			0.21	
XPerm			2.59	
XProt				
Case			5	
Queue at beginning of green arrow, Qa			3.69	
Queue at beginning of unsaturated green, Qu			5.17	
Residual queue, Qr			0.00	
Uniform Delay, d1			35.7	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	26.0	21.0	0.00	0.0	0.0 0.0 0.0	24.5
Westbound								
LTR	0.0 0.0 0.0	0.00	26.0	26.0	0.00	7.0	0.0 0.0 0.0	60.9
Northbound								
DefL	0.0	0.00		35.7	0.00	0.0	0.0	61.3
TR	0.0 0.0	0.00	24.0	16.4	0.00	0.0	0.0 0.0	18.3
Southbound								
LTR	0.0 0.0 0.0	0.00	28.0	27.0	0.00	0.0	0.0 0.0 0.0	42.5
Intersection Delay			43.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LTR			LTR		DefL	TR			LTR	
Init Queue		0.0			0.0		0.0	0.0			0.0	
Flow Rate		292			515		271	411			565	
So		1900			1900		2050	1900			1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	2	0
SL		1034			1185		674	1857			1594	
LnCapacity		436			500		314	867			602	
Flow Ratio		0.3			0.4		0.4	0.2			0.4	
v/c Ratio		0.67			1.03		0.86	0.47			0.94	
Grn Ratio		0.42			0.42		0.47	0.47			0.38	
I Factor		0.830			0.865			1.000			1.000	
AT or PVG		3			3		3	3			3	
Pltn Ratio		1.00			1.00		1.00	1.00			1.00	
PF2		1.00			1.00		1.00	1.00			1.00	
Q1		5.9			12.9		4.0	7.0			13.6	
kB		0.5			0.6		0.5	1.0			0.8	
Q2		1.0			7.3		2.3	0.9			5.6	
Q Average		6.9			20.1		6.3	8.0			19.2	
Q Spacing		25.0			25.0		25.0	25.0			25.0	
Q Storage		0			0		0	0			0	
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2		1.2	1.2			1.2	
BOQ		8.5			24.2		7.7	9.7			23.0	
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4		1.5	1.5			1.4	
BOQ		10.2			28.3		9.3	11.6			27.0	
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5		1.6	1.6			1.5	
BOQ		11.2			30.4		10.3	12.7			29.0	
QSRatio												
95th Percentile Output:												
fB%		1.9			1.6		1.9	1.8			1.6	
BOQ		12.8			32.6		11.8	14.3			31.1	
QSRatio												
98th Percentile Output:												
fB%		2.1			1.7		2.1	2.0			1.7	
BOQ		14.3			34.8		13.3	16.0			33.2	
QSRatio												

ERROR MESSAGES

WARNING: Phase 6 < minimum green time for peds.

Analyst: ML

Agency: AECOM

Date: 08/29/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Sat Flw Rate EB-L = 2100

Year : 2015 FULL Mitigation

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	849	425			462	862				203		206
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	P		
Thru		P			Thru			
Right	P	P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right	P		
Green	37.0	24.0				14.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

L	895	1909	0.98	0.74	37.8	D		
T	1207	1646	0.37	0.73	4.8	A	26.7	C

Westbound

T	502	1881	0.98	0.27	45.2	D	16.2	B
R	1599	1599	0.56	1.00	0.2	A		

Northbound

Southbound

L	504	3239	0.44	0.16	37.2	D	22.6	C
R	928	1492	0.24	0.62	8.2	A		

Intersection Delay = 21.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2015 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	849	425		462	862					203		206
% Heavy Veh	1	1		1	1					1		1
PHF	0.97	0.96		0.94	0.97					0.92		0.92
PK 15 Vol	219	111		123	222					55		56
Hi Ln Vol												
% Grade		0		0						0		
Ideal Sat	2100	1900		1900	1900					1900		1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Lane Width	11.0	12.0		12.0	12.0					10.0		10.0
RTOR Vol					0							0
Adj Flow	875	443		491	889					221		224
%InSharedLn												
Prop LTS	1.000	0.000		0.000								
Prop RTS		0.000		0.000	1.000							1.000
Peds Bikes				0			0			0		
Buses	0	0		0	0					0		0
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0					0.0		0.0
Arriv. Type	3	3		3	3					3		3
Unit Ext.	3.0	3.0		3.0	3.0					3.0		3.0
I Factor		0.508		0.176							1.000	
Lost Time	2.0	2.0		2.0	2.0					2.0		2.0
Ext of g	3.0	2.0		2.0	2.0					2.0		2.0
Ped Min g				24.6			3.2			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds		P P			SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		37.0	24.0				14.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	849	425			462	862							203		206
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	875	443			491	889							221		224
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T				T	R						L		R
Adj flow	875	443			491	889							221		224
Prop LTs	1.000	0.000				0.000									
Prop RTs		0.000			0.000	1.000									1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound	
	L	T			T	R							L	R
So	2100	1900			1900	1900							1900	1900
Lanes	1	1	0	0	1	1	0	0	0				2	1
fW	0.967	1.000			1.000	1.000							0.933	0.933
fHV	0.990	0.990			0.990	0.990							0.990	0.990
fG	1.000	1.000			1.000	1.000*							1.000	1.000
fP	1.000	0.875			1.000	1.000							1.000	1.000
fBB	1.000	1.000			1.000	1.000							1.000	1.000
fA	1.000	1.000			1.000	1.000							1.000	1.000
fLU	1.000	1.000			1.000	1.000							0.971	1.000
fRT		1.000			1.000	0.850								0.850
fLT	0.950	1.000			1.000								0.950	
Sec.	0.138													
fLpb	1.000	1.000			1.000								1.000	
fRpb		1.000			1.000	1.000								1.000
S	1909	1646			1881	1599							3239	1492
Sec.	277													

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Northbound

Southbound

L 0.44 0.16 34.4 1.000 504 0.50 2.8 0.0 37.2 D 22.6 C

R 0.24 0.62 7.6 1.000 928 0.50 0.6 0.0 8.2 A

Intersection delay = 21.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)	66.0			
Effective permitted green time for LT lane group, g(s)	29.0			
Opposing effective green time, go (s)	24.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	875			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	491			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	21.88			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.27			
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73			
gq, (see Exhibit C16-4,5,6,7,8)	24.76			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.24			
n=Max(gq-gf)/2,0)	12.38			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.07			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.138			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

 For special case of single-lane approach opposed by multilane approach,
 see text.
 * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
 left-turn lane and redo calculations.
 ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach
 or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

EB WB NB SB

Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Pedestrian flow rate, Vpedg (p/h)
 OCCpedg
 Opposing queue clearing green, gq (s)
 Eff. ped. green consumed by opp. veh. queue, gq/gp
 OCCpedu
 Opposing flow rate, Vo (veh/h)
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion of left turns, PLT
 Proportion of left turns using protected phase, PLTA
 Left-turn adjustment, fLpb
 Permitted Right Turns
 Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Conflicting bicycle volume, Vbic (bicycles/h)
 Vpedg
 OCCpedg
 Effective green, g (s)
 Vbicg

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	875			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	24.76			
Unopposed green interval, gu	4.24			
Red time r=(C-g-gq-gu)	23.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.24			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.53			
XPerm	3.16			
XProt	0.74			
Case	3			
Queue at beginning of green arrow, Qa	10.41			
Queue at beginning of unsaturated green, Qu	6.02			
Residual queue, Qr	4.82			
Uniform Delay, d1	21.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.1	0.00	0.0	0.0	37.8
T	0.0	0.00	12.0	4.4	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	33.0	32.7	0.00	0.0	0.0	45.2
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.2
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	34.4	0.00	0.0	0.0	37.2
	0.0						0.0	
R	0.0	0.00	17.0	7.6	0.00	0.0	0.0	8.2
Intersection Delay 21.5 sec/veh Intersection LOS C								

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	L	T		T	R				L	R	
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0	
Flow Rate	875	443		491	889				113	224	
So	2100	1900		1900	1900				1900	1900	
No.Lanes	1	1	0	1	1	0	0	0	2	0	1
SL	1203	1646		1881	1599				1668	1492	
LnCapacity	895	1207		502	1599				259	928	
Flow Ratio	0.7	0.3		0.3	0.6				0.1	0.2	
v/c Ratio	0.98	0.37		0.98	0.56				0.44	0.24	
Grn Ratio	0.74	0.73		0.27	1.00				0.16	0.62	
I Factor		0.508		0.176						1.000	
AT or PVG	3	3		3	3				3	3	
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00	
PF2	1.00	1.00		1.00					1.00	1.00	
Q1	9.5	4.0		12.2					2.6	2.5	
kB	0.5	0.7		0.1	0.3				0.4	1.1	
Q2	6.5	0.4		2.2	0.3				0.3	0.3	
Q Average	16.0	4.4		14.3					2.9	2.8	
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0	
Q Storage	0	0		0	0				0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2		1.2					1.3	1.3	
BOQ	19.3	5.5		17.3					3.6	3.6	
QSRatio											
85th Percentile Output:											
fB%	1.4	1.5		1.4					1.6	1.6	
BOQ	22.6	6.7		20.3					4.5	4.4	
QSRatio											
90th Percentile Output:											
fB%	1.5	1.7		1.5					1.8	1.8	
BOQ	24.4	7.5		21.9					5.2	5.1	
QSRatio											
95th Percentile Output:											
fB%	1.6	2.0		1.7					2.2	2.2	
BOQ	26.3	8.9		23.7					6.3	6.1	
QSRatio											
98th Percentile Output:											
fB%	1.8	2.3		1.8					2.5	2.6	
BOQ	28.2	10.3		25.6					7.4	7.2	
QSRatio											

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/8/13	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2015 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	585	45	0	0	45	56	0	0	1	81	0	1279
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		32.0	10.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	830	2025	0.73	0.50	24.7	C		
TR	1066	2132	0.04	0.50	11.6	B	23.7	C

LTR	1161	3266	0.08	0.36	19.4	B	19.4	B
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	546	1403	0.16	0.39	18.4	B	63.3	E
R	888	1599	1.07	0.56	67.4	E		

Intersection Delay = 46.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	585	45	0	0	45	56	0	0	1	81	0	1279
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	152	12	0	0	12	15	0	0	1	22	0	344
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	609	47			95			1			87	947
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase	0.0		0.0									0.0
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.967			1.000			1.000			0.855	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		32.0	10.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	585	45	0	0	45	56	0	0	1	81	0	1279
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	609	47	0	0	49	46	0	0	1	87	0	947
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	609	47			95			1			87	947
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.484			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.950	1.000		1.000			1.000			0.746	
Sec.	0.692										
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	2025	2132		3266			3045			1403	1599
Sec.	1476										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	117	2025	0.06	0.167	338	0.35
Perm		492	1476	# 0.33	0.333	492	1.00
Left		609			0.50	830	0.73
Prot	TR						
Perm							
Thru		47	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot	LTR						
Perm							
Left							
Prot							
Perm							
Thru		95	3266	0.03	0.36	1161	0.08
Right							
Northbound							
Prot	LTR						
Perm							
Left							
Prot							
Perm							
Thru		1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot	LT						
Perm							
Left							
Prot	R						
Perm							
Thru		87	1403	0.06	0.39	546	0.16
Right		947	1599	# 0.59	0.56	888	1.07

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.73	0.50	19.1	1.000	830	0.50	5.5	0.0	24.7	C			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	23.7	C	
Westbound													
LTR	0.08	0.36	19.2	1.000	1161	0.50	0.1	0.0	19.4	B	19.4	B	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.16	0.39	17.9	1.000	546	0.50	0.5	0.0	18.4	B	63.3	E	

R 1.07 0.56 20.0 1.000 888 0.50 47.4 0.0 67.4 E

Intersection delay = 46.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	30.0			
Opposing effective green time, go (s)	32.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	609			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	95			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	15.23			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.25			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.64			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	30.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.44			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.692			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		32.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		32.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	87
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	47	87	1
Lost time for LT lane group, tL	3.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.17
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.59	2.17	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.00	35.00	32.49
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	32.0	32.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	95	47	87	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	32.0	32.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	30.0	32.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.484	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	609			
v/c ratio from Capacity Worksheet, X	0.73			
Protected phase effective green interval, g (s)	15.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	30.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.17			
Protected ph. departure rate, Sp=s/3600	0.563			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.41			
XPerm	1.03			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	0.39			
Queue at beginning of unsaturated green, Qu	7.61			
Residual queue, Qr	0.00			
Uniform Delay, d1	19.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand	Dur. Unmet Demand	Uniform Delay		Initial Queue	Final Unmet	Initial	Lane
	Q veh	t hrs.	Unadj. ds	Adj. d1 sec	Param. u	Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
DefL	0.0	0.00		19.1	0.00	0.0	0.0	24.7
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.0	19.2	0.00	0.0	0.0	19.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.9	0.00	0.0	0.0	18.4
R	0.0	0.00	20.0	20.0	0.00	14.7	0.0	67.4
Intersection Delay			46.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	609	47			49				0				87	947	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1659	2132			1715				1599				1403	1599	
LnCapacity	830	1066			609				621				546	888	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.6	
v/c Ratio	0.73	0.04			0.08				0.00				0.16	1.07	
Grn Ratio	0.50	0.50			0.36				0.39				0.39	0.56	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	8.7	0.6			0.8				0.0				1.4	23.7	
kB	1.0	1.2			0.8				0.8				0.6	0.9	
Q2	2.5	0.1			0.1				0.0				0.1	14.6	
Q Average	11.1	0.7			0.9				0.0				1.5	38.3	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	13.5	0.8			1.1				0.0				2.0	46.0	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	15.9	1.1			1.5				0.0				2.5	53.6	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			1.9				2.0				1.9	1.5	
BOQ	17.3	1.3			1.7				0.0				2.9	57.5	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.4				2.6				2.3	1.6	
BOQ	19.0	1.6			2.2				0.0				3.6	61.3	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.0				3.2				2.8	1.7	
BOQ	20.7	2.0			2.6				0.0				4.3	65.2	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		732	2		5			27	775	1
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	26.0				24.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	815	1881	0.00	0.43	9.7	A	9.7	A
----	-----	------	------	------	-----	---	-----	---

Westbound

L	630	1454	0.96	0.43	42.7	D		
LT	606	1398	0.33	0.43	12.7	B	35.2	D

Northbound

L	165	413	0.04	0.40	11.4	B	11.4	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	1958	4896	0.46	0.40	14.0	B	14.0	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 23.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		732	2		5			27	775	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		201	1		2			8	218	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			603	203		6			902		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.990		1.000				0.033	
Prop RTs	0.000			0.000						0.001		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		26.0							24.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		732	2		5			27	775	1
PHF	0.25	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	4	0		804	2		6			30	871	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	4			603	203		6			902		
Prop LTs	0.000			1.000 0.990			1.000			0.033		
Prop RTs	0.000			0.000						0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.726		0.233		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1454 1398		413		4896	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.43	815	0.00
Right							
Westbound							
Prot							
Perm							
Left	L	603	1454	# 0.41	0.43	630	0.96
Prot							
Perm							
Thru	LT	203	1398	0.15	0.43	606	0.33
Right							
Northbound							
Prot							
Perm							
Left	L	6	413	0.01	0.40	165	0.04
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	902	4896	# 0.18	0.40	1958	0.46
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.00	0.43	9.7	1.000	815	0.50	0.0	0.0	9.7	A	9.7	A
Westbound												
L	0.96	0.43	16.5	1.000	630	0.50	26.2	0.0	42.7	D		
LT	0.33	0.43	11.3	1.000	606	0.50	1.4	0.0	12.7	B	35.2	D
Northbound												
L	0.04	0.40	11.0	1.000	165	0.50	0.4	0.0	11.4	B	11.4	B
Southbound												
LTR	0.46	0.40	13.2	1.000	1958	0.50	0.8	0.0	14.0	B	14.0	B

Intersection delay = 23.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		26.0	24.0	
Effective permitted green time for LT lane group, g(s)		26.0	24.0	
Opposing effective green time, go (s)		26.0	24.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		603	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		4	902	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		10.05	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	5.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57	0.60	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.57	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		26.00	18.43	
n=Max(gq-gf)/2,0)		0.00	2.78	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	3.30	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.70	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.15	0.17	
gdifff=max(gq-gf,0)		0.00	5.57	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.23	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.233	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		26.0		
Effective permitted green time for LT lane group, g(s)		26.0		
Opposing effective green time, go (s)		26.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	201		
Proportion of LT in LT lane group, PLT	0.000	0.990	0.033
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	4		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.35		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.07		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.726		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

_____BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L	LTR		
Init Queue	0.0		0.0	0.0	0.0	0.0		
Flow Rate	4		603	203	6	331		
So	1900		1900	1900	1900	1900		
No.Lanes	0	1	0	1	0	0	3	
SL	1881		1454	1398	413	1797		
LnCapacity	815		630	606	165	718		
Flow Ratio	0.0		0.4	0.1	0.0	0.2		
v/c Ratio	0.00		0.96	0.33	0.04	0.46		
Grn Ratio	0.43		0.43	0.43	0.40	0.40		
I Factor	1.000		0.971		0.951		1.000	
AT or PVG	3		3	3	3	3		
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		
PF2	1.00		1.00	1.00	1.00	1.00		
Q1	0.0		9.7	2.2	0.1	4.1		
kB	0.7		0.6	0.6	0.2	0.7		
Q2	0.0		5.3	0.3	0.0	0.6		
Q Average	0.0		15.0	2.5	0.1	4.6		
Q Spacing	25.0		25.0	25.0	25.0	25.0		
Q Storage	0		0	0	0	0		
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3	1.2		
BOQ	0.1		18.1	3.2	0.1	5.7		
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7	1.5		
BOQ	0.1		21.2	4.0	0.1	7.0		
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0	1.7		
BOQ	0.1		22.9	4.6	0.1	7.9		
QSRatio								
95th Percentile Output:								
fB%	2.6		1.6	2.2	2.6	2.0		
BOQ	0.1		24.7	5.6	0.2	9.3		
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2	2.3		
BOQ	0.1		26.6	6.6	0.2	10.6		
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	211	286	178	0	61	15	672	63	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		24.0					26.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	638	1595	1.04	0.40	63.7	E	54.3	D
R	640	1599	0.23	0.40	12.8	B		

Westbound

LTR	636	1591	0.14	0.40	11.9	B	11.9	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2032	4689	0.39	0.43	12.1	B	12.1	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 32.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	211	286	178	0	61	15	672	63	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	70	95	59	0	18	5	181	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		662	149		91			794				
%InSharedLn												
Prop LTs		0.424			0.000			0.911				
Prop RTs		0.000	1.000		0.198			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		24.0						26.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	211	286	178	0	61	15	672	63	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	281	381	149	0	73	18	723	68	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	662 149			91			794					
Prop LTs	0.424			0.000			0.911					
Prop RTs	0.000 1.000			0.198			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.973			0.999	
fLT	0.821			1.000			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1595	1599		1591			4689	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.04	0.40	18.0	1.000	638	0.50	45.7	0.0	63.7	E	54.3	D
R	0.23	0.40	11.9	1.000	640	0.50	0.8	0.0	12.8	B		
Westbound												
LTR	0.14	0.40	11.5	1.000	636	0.50	0.5	0.0	11.9	B	11.9	B
Northbound												
LTR	0.39	0.43	11.6	1.000	2032	0.50	0.5	0.0	12.1	B	12.1	B
Southbound												

Intersection delay = 32.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	24.0	24.0		
Effective permitted green time for LT lane group, g(s)	24.0	24.0		
Opposing effective green time, go (s)	24.0	24.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	281	0	
Proportion of LT in LT lane group, PLT	0.424	0.000	0.911
Proportion of LT in opposing flow, PLTo	0.00	0.42	
Adjusted opposing flow rate, Vo (veh/h)	91	662	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.68	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.52	11.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.60	0.60	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	12.91	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.00	11.09	
n=Max(gq-gf)/2,0)	0.00	6.46	
PTHo=1-PLTo	1.00	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.00	
EL1 (refer to Exhibit C16-3)	1.52	2.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.29	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.08	
gdifff=max(gq-gf,0)	0.00	12.91	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.46	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.821	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	24.0	24.0	26.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	12.91		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.538		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	91	662	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.424	0.000	0.911	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	24.0	24.0	26.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	24.0	24.0	26.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.198	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	18.0	18.0	0.00	6.0	0.0	63.7
R	0.0	0.00	18.0	11.9	0.00	0.0	0.0	12.8
Westbound								
	0.0						0.0	
LTR	0.0	0.00	18.0	11.5	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.0	11.6	0.00	0.0	0.0	12.1
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			32.3	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	662	149	91		291			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1595	1599	1591		1721			
LnCapacity	638	640	636		745			
Flow Ratio	0.4	0.1	0.1		0.2			
v/c Ratio	1.04	0.23	0.14		0.39			
Grn Ratio	0.40	0.40	0.40		0.43			
I Factor	0.997		0.993		0.967			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	11.0	1.6	1.0		3.3			
kB	0.6	0.6	0.6		0.7			
Q2	8.9	0.2	0.1		0.4			
Q Average	19.9	1.8	1.1		3.7			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.2			
BOQ	23.9	2.3	1.4		4.7			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.5			
BOQ	28.0	2.9	1.8		5.8			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.8	1.9		1.7			
BOQ	30.0	3.4	2.0		6.5			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.3	2.4		2.1			
BOQ	32.2	4.2	2.6		7.8			
QSRatio								
98th Percentile Output:								
fB%	1.7	2.7	2.9		2.4			
BOQ	34.4	5.0	3.1		9.0			
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 08/28/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		160	285	596	168	126	218		404	17	
Lane Width	10.0		13.0		11.0		12.0	12.0		12.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru					Thru	P	P	
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right		P	
SB Right					WB Right			
Green	6.0	16.0				14.0	6.0	
Yellow	3.0	3.0				3.0	3.0	
All Red	2.0	2.0				0.0	2.0	

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	167	1668	0.16	0.10	26.2	C	21.0	C
R	468	1652	0.48	0.28	20.4	C		
Westbound								
LTR	1259	4723	0.96	0.27	31.9	C	31.9	C
Northbound								
L	471	1770	0.29	0.38	16.6	B		
T	714	1863	0.33	0.38	14.2	B	15.1	B
Southbound								
TR	831	3560	0.56	0.23	22.4	C	22.4	C

Intersection Delay = 26.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2015 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		160	285	596	168	126	218		404	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		56	82	171	48	34	59		112	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			12.0	
RTOR Vol			0			0						0
Adj Flow	27		225		1206		137	237			468	
%InSharedLn												
Prop LTS					0.272		1.000	0.000			0.000	
Prop RTS			1.000		0.160			0.000			0.041	
Peds Bikes	0	0		0	0					0	0	
Buses	0		0		0		0	0		0		
%InProtPhase							0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination				1	2	3	4	5	6	7	8
EB	Left	P						NB	Left	P	P
	Thru								Thru	P	P
	Right	P							Right		
	Peds								Peds	X	
WB	Left		P					SB	Left		
	Thru		P						Thru	P	
	Right		P						Right	P	
	Peds		X						Peds	X	
NB	Right							EB	Right	P	
SB	Right							WB	Right		
Green		6.0	16.0						14.0	6.0	
Yellow		3.0	3.0						3.0	3.0	
All Red		2.0	2.0						0.0	2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		160	285	596	168	126	218		404	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		225	328	685	193	137	237		449	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
Lane group	L		R			LTR	L		T			TR
Adj flow	27		225			1206	137	237		468		
Prop LTs						0.272	1.000	0.000		0.000		
Prop RTs			1.000			0.160		0.000		0.041		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	1
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.000	1.000
fHV	0.990	0.990	0.980	0.980	0.980	0.980	0.980	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	0.952	0.952
fRT		0.850	0.976	0.976		1.000	0.994	0.994
fLT	0.950		0.987	0.987	0.950	1.000	1.000	1.000
Sec.					0.392			
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4723	4723	1770	1863	3560	3560
Sec.					731			

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.10	167	0.16
Prot							
Perm							
Thru							
Right	R	225	1652	# 0.14	0.28	468	0.48
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1206	4723	# 0.26	0.27	1259	0.96
Right							
Northbound							
Prot		0	1770	0.00	0.183	325	0.00
Perm		137	731	# 0.19	0.200	146	0.94
Left	L	137			0.38	471	0.29
Prot							
Perm							
Thru	T	237	1863	0.13	0.38	714	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	468	3560	0.13	0.23	831	0.56
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.16	0.10	24.7	1.000	167	0.50	1.5	0.0	26.2	C	21.0	C	
R	0.48	0.28	17.8	1.000	468	0.50	2.5	0.0	20.4	C			
Westbound													
LTR	0.96	0.27	21.7	1.000	1259	0.50	10.2	0.0	31.9	C	31.9	C	
Northbound													
L	0.29	0.38	15.2	1.000	471	0.50	1.4	0.0	16.6	B	15.1	B	
T	0.33	0.38	13.1	1.000	714	0.50	1.1	0.0	14.2	B			
Southbound													
TR	0.56	0.23	20.3	1.000	831	0.50	2.1	0.0	22.4	C	22.4	C	

Intersection delay = 26.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)			23.0	
Effective permitted green time for LT lane group, g(s)			12.0	
Opposing effective green time, go (s)			14.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			137	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			468	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.28	
Opposing lane util. factor, fLUo	0.908		0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.10	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.77	
gq, (see Exhibit C16-4,5,6,7,8)			2.27	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.73	
n=Max(gq-gf)/2,0)			1.14	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.07	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.33	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.39	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.392	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.272 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			14.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			2.27	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.162	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			468	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0		14.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	16.0		14.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.160	0.041
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v			137	
v/c ratio from Capacity Worksheet, X			0.29	
Protected phase effective green interval, g (s)			11.0	
Opposing queue effective green interval, gq			2.27	
Unopposed green interval, gu			9.73	
Red time r=(C-g-gq-gu)			37.0	
Arrival rate, qa=v/(3600(max[X,1.0]))			0.04	
Protected ph. departure rate, Sp=s/3600			0.492	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)			0.25	
XPerm			0.77	
XProt				
Case			4	
Queue at beginning of green arrow, Qa			0.00	
Queue at beginning of unsaturated green, Qu			1.49	
Residual queue, Qr			0.00	
Uniform Delay, d1			15.2	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet	Unmet			Queue	Unmet	Queue	Group
	Demand	Demand	Unadj.	Adj.	Param.	Demand	Delay	Delay
Group	Q veh	t hrs.	ds	d1 sec	u	Q veh	d3 sec	d sec
Eastbound								
L	0.0	0.00	27.0	24.7	0.00	0.0	0.0	26.2
	0.0						0.0	
R	0.0	0.00	21.5	17.8	0.00	0.0	0.0	20.4
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.0	21.7	0.00	0.0	0.0	31.9
	0.0						0.0	
Northbound								
L	0.0	0.00		15.2	0.00	0.0	0.0	16.6
T	0.0	0.00	18.5	13.1	0.00	0.0	0.0	14.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	23.0	20.3	0.00	0.0	0.0	22.4
	0.0						0.0	

Intersection Delay 26.0 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	L		R	LTR		L		T	TR			
Init Queue	0.0		0.0	0.0		0.0		0.0	0.0			
Flow Rate	27		225	442		137		237	245			
So	1900		1900	1900		1900		1900	1900			
No.Lanes	1	0	1	0	3	0	1	1	0	0	2	0
SL	1668		1652	1733		1228		1863	1869			
LnCapacity	167		468	462		471		714	436			
Flow Ratio	0.0		0.1	0.3		0.1		0.1	0.1			
v/c Ratio	0.16		0.48	0.96		0.29		0.33	0.56			
Grn Ratio	0.10		0.28	0.27		0.38		0.38	0.23			
I Factor			0.717	0.483				0.917	0.747			
AT or PVG	3		3	3		3		3	3			
Pltn Ratio	1.00		1.00	1.00		1.00		1.00	1.00			
PF2	1.00		1.00	1.00		1.00		1.00	1.00			
Q1	0.4		3.1	7.3		1.5		2.8	3.6			
kB	0.2		0.4	0.2		0.5		0.6	0.4			
Q2	0.0		0.3	2.6		0.2		0.3	0.5			
Q Average	0.4		3.4	9.9		1.7		3.1	4.1			
Q Spacing	25.0		25.0	25.0		25.0		25.0	25.0			
Q Storage	0		0	0		0		0	0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3		1.3	1.2		1.3		1.3	1.2			
BOQ	0.6		4.3	12.0		2.1		3.9	5.0			
QSRatio												
85th Percentile Output:												
fB%	1.7		1.6	1.4		1.6		1.6	1.5			
BOQ	0.7		5.3	14.2		2.7		4.8	6.2			
QSRatio												
90th Percentile Output:												
fB%	2.0		1.8	1.6		1.9		1.8	1.7			
BOQ	0.9		6.0	15.5		3.1		5.5	7.0			
QSRatio												
95th Percentile Output:												
fB%	2.5		2.1	1.7		2.3		2.1	2.0			
BOQ	1.1		7.2	17.2		3.9		6.6	8.3			
QSRatio												
98th Percentile Output:												
fB%	3.1		2.5	1.9		2.8		2.5	2.4			
BOQ	1.4		8.4	18.8		4.7		7.8	9.6			
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

Mitigation

2020

Weekday

AM

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			216	89		45	208	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			260	107		54	250	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		150		39				
Peak Hour Factor, PHF		0.69		0.69				
Hourly Flow Rate, HFR		217		56				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage					/			
Lanes		1		1				
Configuration		L		R				

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		54	217		56			
C(m) (vph)		1144	404		731			
v/c		0.05	0.54		0.08			
95% queue length		0.15	3.08		0.25			
Control Delay		8.3	23.8		10.3			
LOS		A	C		B			
Approach Delay				21.0				
Approach LOS				C				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		216	89	45	208	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		65	27	14	63	
Hourly Flow Rate, HFR		260	107	54	250	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	150		39			
Peak Hour Factor, PHF	0.69		0.69			
Peak-15 Minute Volume	54		14			
Hourly Flow Rate, HFR	217		56			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		250
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		367	672		314			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	314	
Potential Capacity	731	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	731	
Probability of Queue free St.	0.92	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	367	
Potential Capacity	1144	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1144	
Probability of Queue free St.	0.95	1.00
Maj L-Shared Prob Q free St.	0.94	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.94	0.94
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	672	
Potential Capacity	424	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.94
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.88
Movement Capacity	404	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.94 0.94
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 672
Potential Capacity 424
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.94
Maj. L, Min T Adj. Imp Factor. 0.96
Cap. Adj. factor due to Impeding mvmnt 0.95 0.88
Movement Capacity 404

Results for Two-stage process:
a
y
C t 404

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	217		56			
Movement Capacity (vph)	404		731			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	404		731			
Volume	217		56			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		54	217		56			
C(m) (vph)		1144	404		731			
v/c		0.05	0.54		0.08			
95% queue length		0.15	3.08		0.25			
Control Delay		8.3	23.8		10.3			
LOS		A	C		B			
Approach Delay				21.0				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.95
v(il), Volume for stream 2 or 5		250
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.94
d(M,LT), Delay for stream 1 or 4		8.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.5

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	3	6	1	284	34	227	0	205	308	121	160	9
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	708	1699	0.02	0.42	10.3	B	10.3	B
Westbound								
LT	530	1272	0.69	0.42	21.1	C	19.1	B
R	514	1233	0.51	0.42	16.3	B		
Northbound								
LT	702	1684	0.34	0.42	13.1	B	15.7	B
R	606	1455	0.60	0.42	17.4	B		
Southbound								
L	399	957	0.35	0.42	14.3	B		
TR	676	1622	0.29	0.42	12.7	B	13.4	B

Intersection Delay = 16.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	284	34	227	0	205	308	121	160	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	82	10	65	0	60	91	35	46	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900	1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		11			365	261		241	362	139	194	
%InSharedLn												
Prop LTs		0.273			0.893			0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.000	1.000		0.052	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4	0	0	3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	284	34	227	0	205	308	121	160	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	326	39	261	0	241	362	139	184	10
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	11			365 261			241 362			139 194		
Prop LTs	0.273			0.893			0.000			1.000 0.000		
Prop RTs	0.091			0.000 1.000			0.000 1.000			0.052		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.990			0.935 0.935			0.901 0.901			0.901 0.901		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.984 1.000			1.000 0.988		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.988			1.000 0.850			1.000 0.850			0.992		
fLT	0.936			0.741			1.000			0.599 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1699			1272 1233			1684 1455			957 1622		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1699	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	365	1272	# 0.29	0.42	530	0.69
Right	R	261	1233	0.21	0.42	514	0.51
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	241	1684	0.14	0.42	702	0.34
Right	R	362	1455	# 0.25	0.42	606	0.60
Southbound							
Prot							
Perm							
Left	L	139	957	0.15	0.42	399	0.35
Prot							
Perm							
Thru	TR	194	1622	0.12	0.42	676	0.29
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.69	0.42	14.3	1.000	530	0.50	6.7	0.0	21.1	C	19.1	B
R	0.51	0.42	12.9	1.000	514	0.50	3.3	0.0	16.3	B		
Northbound												
LT	0.34	0.42	11.9	1.000	702	0.50	1.2	0.0	13.1	B	15.7	B
R	0.60	0.42	13.6	1.000	606	0.50	3.8	0.0	17.4	B		
Southbound												
L	0.35	0.42	11.9	1.000	399	0.50	2.4	0.0	14.3	B		
TR	0.29	0.42	11.6	1.000	676	0.50	1.1	0.0	12.7	B	13.4	B

Intersection delay = 16.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				139
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				241
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				2.32
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.02
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				0.41
gu=g-gq if gq>=gf, or = g-gf if gq<gf				24.59
n=Max(gq-gf)/2,0)				0.21
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.64
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.16
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.60
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.599

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	3	326	0	
Proportion of LT in LT lane group, PLT	0.273	0.893	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.00	
Adjusted opposing flow rate, Vo (veh/h)	365	11	194	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.43	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.08	0.18	3.23	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	6.04	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	25.00	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.11	0.73	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	
EL1 (refer to Exhibit C16-3)	2.01	1.39	1.69	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.936	0.741	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	6.04			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.242			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	365			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	21.1
R	0.0	0.00	17.5	12.9	0.00	0.0	0.0	16.3
Northbound								
	0.0						0.0	
LT	0.0	0.00	17.5	11.9	0.00	0.0	0.0	13.1
R	0.0	0.00	17.5	13.6	0.00	0.0	0.0	17.4
Southbound								
L	0.0	0.00	17.5	11.9	0.00	0.0	0.0	14.3
TR	0.0	0.00	17.5	11.6	0.00	0.0	0.0	12.7
	0.0						0.0	
Intersection Delay			16.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	11		365	261	241	362	139	194
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	1 1	0
SL	1699		1272	1233	1684	1455	957	1622
LnCapacity	708		530	514	702	606	399	676
Flow Ratio	0.0		0.3	0.2	0.1	0.2	0.1	0.1
v/c Ratio	0.02		0.69	0.51	0.34	0.60	0.35	0.29
Grn Ratio	0.42		0.42	0.42	0.42	0.42	0.42	0.42
I Factor	1.000		0.940		0.887			1.000
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1		5.0	3.2	2.7	4.7	1.6	2.1
kB	0.7		0.5	0.5	0.6	0.5	0.5	0.7
Q2	0.0		1.1	0.5	0.3	0.8	0.2	0.3
Q Average	0.1		6.1	3.7	3.0	5.5	1.8	2.4
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.3	1.3
BOQ	0.2		7.5	4.7	3.8	6.7	2.3	3.0
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.6	1.5	1.6	1.6
BOQ	0.2		9.0	5.8	4.8	8.2	2.9	3.8
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.7	1.8	1.7	1.8	1.8
BOQ	0.2		10.0	6.5	5.4	9.1	3.4	4.3
QSRatio								
95th Percentile Output:								
fB%	2.6		1.9	2.1	2.1	1.9	2.3	2.2
BOQ	0.3		11.5	7.7	6.5	10.6	4.2	5.3
QSRatio								
98th Percentile Output:								
fB%	3.2		2.1	2.4	2.5	2.2	2.7	2.6
BOQ	0.4		13.0	9.0	7.7	12.0	5.0	6.3
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				62		179	549	74		120	359	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 382 1434 0.68 0.27 28.8 C 28.8 C

Northbound

TR 1033 1823 0.71 0.57 12.6 B 12.6 B

Southbound

L 265 468 0.52 0.57 14.0 B
 T 911 1607 0.45 0.57 9.0 A 10.2 B

Intersection Delay = 14.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				62		179	549	74		120	359	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				17		48	161	22		34	103	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					259			733		138	413	
%InSharedLn												
Prop LTs					0.259			0.000		1.000	0.000	
Prop RTs					0.741			0.119			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet					0.0			0.0		0.0	0.0	
Arriv. Type					3			3		3	3	
Unit Ext.					3.0			3.0		3.0	3.0	
I Factor					0.980			0.769			0.842	
Lost Time					2.0			2.0		2.0	2.0	
Ext of g					2.0			2.0		2.0	2.0	
Ped Min g		11.8			11.8			14.1				

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				62		179	549	74		120	359	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				67		192	646	87		138	413	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					259			733		138	413	
Prop LTs					0.259			0.000		1.000	0.000	
Prop RTs					0.741			0.119			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.971			0.901			0.917	0.917	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.984			1.000	0.988	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.900			0.984				1.000	
fLT				0.987			1.000			0.288	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1434			1823			468	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	259	1434	# 0.18	0.27	382	0.68
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	733	1823	# 0.40	0.57	1033	0.71
Right							
Southbound							
Prot							
Perm							
Left	L	138	468	0.29	0.57	265	0.52
Prot							
Perm							
Thru	T	413	1607	0.26	0.57	911	0.45
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.68	0.27	19.7	1.000	382	0.50	9.1	0.0	28.8	C	28.8	C
Northbound												
TR	0.71	0.57	9.4	1.000	1033	0.50	3.2	0.0	12.6	B	12.6	B
Southbound												
L	0.52	0.57	8.0	1.000	265	0.50	6.0	0.0	14.0	B		
T	0.45	0.57	7.6	1.000	911	0.50	1.4	0.0	9.0	A	10.2	B

Intersection delay = 14.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				138
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				733
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				2.30
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				12.22
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				8.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.29
n=Max(gq-gf)/2,0)				4.35
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.58
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.29
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.288

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.259 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.71
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.256
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				733
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.741	0.119
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.7	0.00	0.0	0.0	28.8
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.4	0.00	0.0	0.0	12.6
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	8.0	0.00	0.0	0.0	14.0
T	0.0	0.00	13.0	7.6	0.00	0.0	0.0	9.0
	0.0						0.0	
Intersection Delay			14.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup										L	T	
Init Queue										0.0	0.0	
Flow Rate										138	413	
So										1900	1900	
No.Lanes	0	0	0	0	0	0	0	1	0	1	1	0
SL										468	1607	
LnCapacity										265	911	
Flow Ratio										0.3	0.3	
v/c Ratio										0.52	0.45	
Grn Ratio										0.57	0.57	
I Factor											0.842	
AT or PVG										3	3	
Pltn Ratio										1.00	1.00	
PF2										1.00	1.00	
Q1										1.4	4.0	
kB										0.3	0.7	
Q2										0.3	0.6	
Q Average										1.7	4.6	
Q Spacing										25.0	25.0	
Q Storage										0	0	
Q S Ratio												
70th Percentile Output:												
fB%										1.3	1.2	
BOQ										2.2	5.7	
QSRatio												
85th Percentile Output:												
fB%										1.6	1.5	
BOQ										2.8	6.9	
QSRatio												
90th Percentile Output:												
fB%										1.9	1.7	
BOQ										3.2	7.8	
QSRatio												
95th Percentile Output:												
fB%										2.3	2.0	
BOQ										4.0	9.1	
QSRatio												
98th Percentile Output:												
fB%										2.8	2.3	
BOQ										4.8	10.5	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 FULL Mitigation
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	73	183	169	203	441	79	107	251	74	68	31	41
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	577	0.43	0.33	28.8	C		
T	621	1863	0.33	0.33	23.6	C	24.6	C
R	493	1478	0.30	0.33	23.5	C		
Westbound								
L	311	933	0.75	0.33	41.6	D		
TR	1092	3277	0.54	0.33	26.3	C	30.6	C
Northbound								
LT	932	3355	0.41	0.28	27.9	C	27.6	C
R	388	1396	0.21	0.28	26.1	C		
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	350	1574	0.31	0.22	31.4	C	31.1	C

Intersection Delay = 28.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Veterans Road West

N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	73	183	169	203	441	79	107	251	74	68	31	41
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	21	52	48	58	127	23	29	67	20	25	12	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	83	208	149	233	593			385	80	101	107	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.299			0.000	
Prop RTS		0.000	1.000		0.145			0.000	1.000		0.570	
Peds Bikes	0			0	0	0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.780			0.979			1.000			0.991	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination				1	2	3	4	5	6	7	8
EB	Left	P						NB	Left	P	
	Thru	P							Thru	P	
	Right	P							Right	P	
	Peds								Peds		
WB	Left	P						SB	Left	P	
	Thru	P							Thru	P	
	Right	P							Right	P	
	Peds	X							Peds		
NB	Right							EB	Right		
SB	Right							WB	Right		
Green		30.0							25.0	20.0	
Yellow		3.0							3.0	3.0	
All Red		2.0							2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	73	183	169	203	441	79	107	251	74	68	31	41
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	83	208	149	233	507	86	115	270	80	101	46	61
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	83	208	149	233	593			385	80	101	107	
Prop LTs	1.000	0.000		1.000	0.000			0.299			0.000	
Prop RTs		0.000	1.000		0.145			0.000	1.000		0.570	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.980	0.980	0.980	0.926	0.926		0.926	0.926		0.971	0.971	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.978		1.000	0.850			0.914	
fLT	0.321	1.000		0.568	1.000		0.985			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	577	1863	1478	933	3277		3355	1396		1694	1574	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	83	577	0.14	0.33	192	0.43
Prot							
Perm							
Thru	T	208	1863	0.11	0.33	621	0.33
Right	R	149	1478	0.10	0.33	493	0.30
Westbound							
Prot							
Perm							
Left	L	233	933	# 0.25	0.33	311	0.75
Prot							
Perm							
Thru	TR	593	3277	0.18	0.33	1092	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	385	3355	# 0.11	0.28	932	0.41
Right	R	80	1396	0.06	0.28	388	0.21
Southbound							
Prot							
Perm							
Left	L	101	1694	0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	107	1574	# 0.07	0.22	350	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.43
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.43	0.33	23.4	1.000	192	0.50	5.5	0.0	28.8	C		
T	0.33	0.33	22.5	1.000	621	0.50	1.1	0.0	23.6	C	24.6	C
R	0.30	0.33	22.2	1.000	493	0.50	1.2	0.0	23.5	C		
Westbound												
L	0.75	0.33	26.7	1.000	311	0.50	14.9	0.0	41.6	D		
TR	0.54	0.33	24.4	1.000	1092	0.50	1.9	0.0	26.3	C	30.6	C
Northbound												
LT	0.41	0.28	26.5	1.000	932	0.50	1.4	0.0	27.9	C	27.6	C
R	0.21	0.28	24.9	1.000	388	0.50	1.2	0.0	26.1	C		
Southbound												
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C		
TR	0.31	0.22	29.2	1.000	350	0.50	2.2	0.0	31.4	C	31.1	C

Intersection delay = 28.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	83	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	593	208		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.08	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.79	5.20		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.55	2.84		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.45	27.16		
n=Max(gq-gf)/2,0)	3.78	1.42		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.33	1.59		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.57		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.321	0.568		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.299 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.55			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.252			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	593			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.145
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	23.4	0.00	0.0	0.0	28.8
T	0.0	0.00	30.0	22.5	0.00	0.0	0.0	23.6
R	0.0	0.00	30.0	22.2	0.00	0.0	0.0	23.5
Westbound								
L	0.0	0.00	30.0	26.7	0.00	0.0	0.0	41.6
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	32.5	26.5	0.00	0.0	0.0	27.9
R	0.0	0.00	32.5	24.9	0.00	0.0	0.0	26.1
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	29.2	0.00	0.0	0.0	31.4
	0.0						0.0	

Intersection Delay	28.6	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	L	T	R	L	TR	LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	83	208	149	233	311	202	80	101	107
So	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	2	2	1	1	0
SL	577	1863	1478	933	1721	1762	1396	1694	1574
LnCapacity	192	621	493	311	573	489	388	376	350
Flow Ratio	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
v/c Ratio	0.43	0.33	0.30	0.75	0.54	0.41	0.21	0.27	0.31
Grn Ratio	0.33	0.33	0.33	0.33	0.33	0.28	0.28	0.22	0.22
I Factor		0.780			0.979	1.000			0.991
AT or PVG	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.6	3.9	2.8	5.2	6.3	4.1	1.5	2.1	2.2
kB	0.3	0.6	0.5	0.5	0.8	0.7	0.6	0.6	0.5
Q2	0.2	0.3	0.2	1.3	0.9	0.5	0.2	0.2	0.2
Q Average	1.8	4.2	3.0	6.5	7.2	4.6	1.7	2.3	2.5
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2	1.3	1.2	1.2	1.2	1.3	1.3	1.3
BOQ	2.3	5.2	3.8	7.9	8.8	5.7	2.1	2.9	3.1
QSRatio									
85th Percentile Output:									
fB%	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6	1.6
BOQ	2.9	6.5	4.7	9.6	10.6	7.0	2.7	3.7	3.9
QSRatio									
90th Percentile Output:									
fB%	1.8	1.7	1.8	1.6	1.6	1.7	1.9	1.8	1.8
BOQ	3.4	7.2	5.3	10.6	11.7	7.8	3.1	4.2	4.5
QSRatio									
95th Percentile Output:									
fB%	2.3	2.0	2.1	1.9	1.8	2.0	2.3	2.2	2.2
BOQ	4.2	8.6	6.4	12.1	13.2	9.2	3.9	5.1	5.5
QSRatio									
98th Percentile Output:									
fB%	2.7	2.3	2.5	2.1	2.1	2.3	2.8	2.6	2.6
BOQ	5.0	9.9	7.6	13.7	14.8	10.6	4.7	6.1	6.5
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/28/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR			LTR		DefL	TR		L	TR	
Volume	54	32	227	177	355	6	270	93	51	11	160	102
Lane Width	10.0	12.0			12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	48.0				32.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	334	626	0.18	0.53	12.0	B		
TR	1551	2909	0.19	0.53	11.2	B	11.3	B
Westbound								
LTR	1378	2583	0.45	0.53	13.9	B	13.9	B
Northbound								
DefL	349	981	0.89	0.36	54.1	D		
TR	635	1787	0.26	0.36	21.6	C	42.8	D
Southbound								
L	367	1032	0.04	0.36	19.1	B		
TR	1028	2892	0.34	0.36	22.1	C	22.0	C

Intersection Delay = 22.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	54	32	227	177	355	6	270	93	51	11	160	102
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	9	64	51	102	2	78	27	15	4	53	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR			LTR		DefL	TR		L	TR	
Lane Width	10.0	12.0			12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	61	294			618		310	166		14	345	
%InSharedLn												
Prop LTS	1.000	0.000			0.328		1.000	0.000		1.000	0.000	
Prop RTS		0.878			0.011			0.355			0.388	
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3			3	3		3	3	
Unit Ext.	3.0	3.0		3.0			3.0	3.0		3.0	3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time	2.0	2.0		2.0			2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		48.0						32.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	54	32	227	177	355	6	270	93	51	11	160	102
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	61	36	258	203	408	7	310	107	59	14	211	134
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR			LTR		DefL	TR		L	TR	
Adj flow	61	294			618		310	166		14	345	
Prop LTs	1.000	0.000			0.328		1.000	0.000		1.000	0.000	
Prop RTs		0.878			0.011			0.355			0.388	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound		Northbound		Southbound	
	L	TR		LTR		DefL	TR	L	TR
So	1900	1900		1900		1900	1900	1900	1900
Lanes	1	2	0	2	0	0	2	1	2
fW	0.933	1.000		1.000		1.033	1.033	0.900	0.917
fHV	0.926	0.926		0.971		0.962	0.962	0.926	0.926
fG	1.000	1.000		1.000		1.000	1.000	1.000	1.000
fP	1.000	1.000		1.000		1.000	1.000	1.000	1.000
fBB	1.000	1.000		1.000		1.000	1.000	1.000	1.000
fA	1.000	1.000		1.000		1.000	1.000	1.000	1.000
fLU	1.000	0.952		0.952		1.000	1.000	1.000	0.952
fRT		0.868		0.998			0.947		0.942
fLT	0.381	1.000		0.737		0.520	1.000	0.652	1.000
Sec.									
fLpb	1.000	1.000		1.000		1.000	1.000	1.000	1.000
fRpb		1.000		1.000			1.000		1.000
S	626	2909		2583		981	1787	1032	2892
Sec.									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	61	626	0.10	0.53	334	0.18
Prot							
Perm							
Thru	TR	294	2909	0.10	0.53	1551	0.19
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	618	2583	# 0.24	0.53	1378	0.45
Right							
Northbound							
Prot							
Perm							
Left	DefL	310	981	# 0.32	0.36	349	0.89
Prot							
Perm							
Thru	TR	166	1787	0.09	0.36	635	0.26
Right							
Southbound							
Prot							
Perm							
Left	L	14	1032	0.01	0.36	367	0.04
Prot							
Perm							
Thru	TR	345	2892	0.12	0.36	1028	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.56
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.62

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.18	0.53	10.9	1.000	334	0.50	1.1	0.0	12.0	B		
TR	0.19	0.53	10.9	1.000	1551	0.50	0.2	0.0	11.2	B	11.3	B
Westbound												
LTR	0.45	0.53	12.9	1.000	1378	0.50	1.0	0.0	13.9	B	13.9	B
Northbound												
DefL	0.89	0.36	27.3	1.000	349	0.50	26.8	0.0	54.1	D		
TR	0.26	0.36	20.6	1.000	635	0.50	1.0	0.0	21.6	C	42.8	D
Southbound												
L	0.04	0.36	18.9	1.000	367	0.50	0.2	0.0	19.1	B		
TR	0.34	0.36	21.2	1.000	1028	0.50	0.9	0.0	22.1	C	22.0	C

Intersection delay = 22.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	48.0		32.0	32.0
Effective permitted green time for LT lane group, g(s)	48.0		32.0	32.0
Opposing effective green time, go (s)	48.0		32.0	32.0
Number of lanes in LT lane group, N	1		1	1
Number of lanes in opposing approach, No	2		2	2
Adjusted LT flow rate, VLT (veh/h)	61		310	14
Proportion of LT in LT lane group, PLT	1.000		1.000	1.000
Proportion of LT in opposing flow, PLTo	0.33		0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	618		345	166
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.53		7.75	0.35
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.11		4.53	2.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.47		0.64	0.64
gq, (see Exhibit C16-4,5,6,7,8)	4.24		1.49	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	43.76		30.51	32.00
n=Max(gq-gf)/2,0)	2.12		0.75	0.00
PTHo=1-PLTo	0.67		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	1.00
EL1 (refer to Exhibit C16-3)	2.39		1.83	1.53
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.74			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08		0.13	0.13
gdifff=max(gq-gf,0)	4.24		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.38		0.52	0.65
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.381		0.520	0.652

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		48.0		
Effective permitted green time for LT lane group, g(s)		48.0		
Opposing effective green time, go (s)		48.0		
Number of lanes in LT lane group, N		2		

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	203
Proportion of LT in LT lane group, PLT	0.000 0.328 0.000 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	294
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	5.08
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.86
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.47
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	48.00
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.86
EL1 (refer to Exhibit C16-3)	1.90
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.08
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.56
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.737

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	48.0	48.0		32.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	4.24	0.00		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.088	0.000		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	618	294		166
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	0.328		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	48.0	48.0	32.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	48.0	48.0	32.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.878	0.011	0.355
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	21.0	10.9	0.00	0.0	0.0	12.0
TR	0.0	0.00	21.0	10.9	0.00	0.0	0.0	11.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.0	12.9	0.00	0.0	0.0	13.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00	29.0	27.3	0.00	0.0	0.0	54.1
TR	0.0	0.00	29.0	20.6	0.00	0.0	0.0	21.6
	0.0						0.0	
Southbound								
L	0.0	0.00	29.0	18.9	0.00	0.0	0.0	19.1
TR	0.0	0.00	29.0	21.2	0.00	0.0	0.0	22.1
	0.0						0.0	

Intersection Delay	22.6	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound	Northbound			Southbound		
LaneGroup	L	TR		LTR	DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Flow Rate	61	154		324	310	166		14	181	
So	1900	1900		1900	1900	1900		1900	1900	
No.Lanes	1	2	0	2	0	2	0	1	2	0
SL	626	1527		1356	981	1787		1032	1518	
LnCapacity	334	814		723	349	635		367	539	
Flow Ratio	0.1	0.1		0.2	0.3	0.1		0.0	0.1	
v/c Ratio	0.18	0.19		0.45	0.89	0.26		0.04	0.34	
Grn Ratio	0.53	0.53		0.53	0.36	0.36		0.36	0.36	
I Factor		0.916		0.953		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Q1	0.8	2.0		5.0	7.3	2.9		0.2	3.3	
kB	0.5	0.9		0.9	0.5	0.8		0.6	0.7	
Q2	0.1	0.2		0.7	2.8	0.3		0.0	0.4	
Q Average	0.9	2.2		5.7	10.1	3.2		0.3	3.7	
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0	0		0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3		1.2	1.2	1.3		1.3	1.2	
BOQ	1.2	2.8		7.0	12.2	4.1		0.3	4.6	
QSRatio										
85th Percentile Output:										
fB%	1.7	1.6		1.5	1.4	1.6		1.7	1.5	
BOQ	1.5	3.5		8.5	14.5	5.0		0.4	5.7	
QSRatio										
90th Percentile Output:										
fB%	1.9	1.8		1.7	1.6	1.8		2.0	1.7	
BOQ	1.7	4.0		9.4	15.8	5.7		0.5	6.4	
QSRatio										
95th Percentile Output:										
fB%	2.4	2.2		1.9	1.7	2.1		2.6	2.1	
BOQ	2.2	5.0		10.9	17.5	6.9		0.6	7.7	
QSRatio										
98th Percentile Output:										
fB%	3.0	2.7		2.2	1.9	2.5		3.1	2.4	
BOQ	2.6	5.9		12.4	19.1	8.1		0.8	8.9	
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/29/2013	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Period	Year : 2020 FULL Mitigation
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L		TR		LT	R			LTR	L		LT R
Volume	798	259	19	4	284	327	4	16	6	121	5	146
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

		Signal Operations								
Phase	Combination	1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds			
WB	Left		P			SB	Left	P		
	Thru		P				Thru	P		
	Right	P	P				Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right	P		
Green		37.0	22.0					16.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Intersection Performance Summary								
Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	839	1728	1.05	0.71	55.6	E		
TR	1158	1629	0.26	0.71	5.0	A	42.5	D
Westbound								
LT	449	1835	0.75	0.24	41.5	D	19.6	B
R	1568	1568	0.24	1.00	0.3	A		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.62	0.18	46.1	D		
LT	320	1801	0.02	0.18	30.6	C	24.7	C
R	952	1478	0.18	0.64	6.8	A		
Intersection Delay = 32.6 (sec/veh) Intersection LOS = C								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	798	259	19	4	284	327	4	16	6	121	5	146
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	219	71	5	1	83	95	3	11	4	35	2	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0		0				0
Adj Flow	877	306			335	380		70		139	6	168
%InSharedLn										0		
Prop LTS	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTS		0.069			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0		0	0		
Buses	0	0		0	0		0		0	0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	798	259	19		4	284	327		4	16	6		121	5	146
PHF	0.91	0.91	0.91		0.86	0.86	0.86		0.37	0.37	0.37		0.87	0.87	0.87
Adj flow	877	285	21		5	330	380		11	43	16		139	6	168
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT R				LTR			L	LT R	
Adj flow	877	306				335 380				70			139	6	168
Prop LTs	1.000	0.000				0.015				0.157			1.000	0.000	
Prop RTs	0.069				0.000 1.000				0.229				0.000 1.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.990			1.000	0.850			0.969					1.000	0.850
fLT	0.950	1.000			0.995				0.965				0.732	1.000	
Sec.	0.237														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1629			1835	1568			1995				1273	1801	1478
Sec.	431														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		167	431	# 0.39	0.300	129	1.29
Left	L	877			0.71	839	1.05
Prot							
Perm							
Thru	TR	306	1629	0.19	0.71	1158	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	335	1835	0.18	0.24	449	0.75
Right	R	380	1568	0.24	1.00	1568	0.24
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	139	1273	# 0.11	0.18	226	0.62
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	168	1478	0.11	0.64	952	0.18

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.91
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.02

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.05	0.71	18.7	1.000	839	0.50	36.9	0.0	55.6	E			
TR	0.26	0.71	4.6	1.000	1158	0.50	0.3	0.0	5.0	A	42.5	D	
Westbound													
LT	0.75	0.24	31.4	1.000	449	0.50	10.1	0.0	41.5	D	19.6	B	
R	0.24	1.00	0.0	0.950	1568	0.50	0.3	0.0	0.3	A			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.62	0.18	34.2	1.000	226	0.50	11.9	0.0	46.1	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	24.7	C	

R 0.18 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 32.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	877			139
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.16
Adjusted opposing flow rate, Vo (veh/h)	335			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.93			3.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.38			1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	15.55			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.45			14.85
n=Max(gq-gf)/2,0)	7.77			0.58
PTHo=1-PLTo	0.99			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.79			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.39			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15			0.25
gdifff=max(gq-gf,0)	15.55			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.24			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.237			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.015	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	306	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.65	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.89	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		306		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.015		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.069
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	877			
v/c ratio from Capacity Worksheet, X	1.05			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	15.55			
Unopposed green interval, gu	11.45			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	1.95			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	9.12			
Queue at beginning of unsaturated green, Qu	3.62			
Residual queue, Qr	3.06			
Uniform Delay, d1	18.7			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand	Dur. Unmet Demand	Uniform Delay		Initial Queue Param.	Final Unmet Demand	Initial Queue Delay	Lane Group Delay
	Q veh	t hrs.	Unadj. ds	Adj. d1 sec	u	Q veh	d3 sec	d sec
Eastbound								
L	0.0	0.00		18.7	0.00	9.5	0.0	55.6
TR	0.0	0.00	13.0	4.6	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.4	0.00	0.0	0.0	41.5
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	34.2	0.00	0.0	0.0	46.1
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8

Intersection Delay	32.6	sec/veh	Intersection LOS	C
--------------------	------	---------	------------------	---

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	877	306		335	380	70		139	6	168
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1181	1629		1835	1568	1995		1273	1801	1478
LnCapacity	839	1158		449	1568	355		226	320	952
Flow Ratio	0.7	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	1.05	0.26		0.75	0.24	0.20		0.62	0.02	0.18
Grn Ratio	0.71	0.71		0.24	1.00	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	10.8	2.7		7.7		1.5		3.2	0.1	1.7
kB	0.6	0.8		0.6	1.5	0.6		0.4	0.5	1.1
Q2	10.9	0.3		1.6	0.5	0.1		0.6	0.0	0.2
Q Average	21.6	3.0		9.3		1.6		3.8	0.1	1.9
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2		1.3		1.2	1.3	1.3
BOQ	26.0	3.8		11.4		2.1		4.8	0.2	2.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.4		1.6		1.5	1.7	1.6
BOQ	30.4	4.7		13.5		2.6		5.9	0.2	3.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6		1.9		1.7	2.0	1.8
BOQ	32.6	5.3		14.7		3.0		6.6	0.3	3.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8		2.3		2.1	2.6	2.3
BOQ	34.9	6.4		16.4		3.8		7.9	0.3	4.4
QSRatio										
98th Percentile Output:										
fB%	1.7	2.5		1.9		2.8		2.4	3.2	2.7
BOQ	37.2	7.6		18.0		4.5		9.2	0.4	5.2
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	214	0		382	191		3			24	487	121
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		30.0					20.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	932	1863	0.29	0.50	9.5	A	9.5	A
----	-----	------	------	------	-----	---	-----	---

Westbound

L	522	1043	0.93	0.50	38.6	D		
T	953	1906	0.25	0.50	9.2	A	28.8	C

Northbound

L	145	435	0.03	0.33	13.8	B	13.8	B
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Southbound

LTR	1601	4802	0.49	0.33	17.0	B	17.0	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 20.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		214	0	382	191		3			24	487	121
% Heavy Veh		2	2	3	3		1			1	1	1
PHF		0.80	0.25	0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol		67	0	121	60		1			7	150	37
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		267		484	242		4				780	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.038	
Prop RTs		0.000			0.000						0.191	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.981			0.998		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							20.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	214	0		382	191		3			24	487	121
PHF	0.80	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	267	0		484	242		4			30	601	149
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	267			484	242		4			780		
Prop LTs	0.000			1.000	0.000		1.000			0.038		
Prop RTs	0.000			0.000						0.191		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.971	
fLT	1.000		0.547 1.000		0.248		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1043 1906		435		4802	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	267	1863	0.14	0.50	932	0.29
Right							
Westbound							
Prot							
Perm							
Left	L	484	1043	# 0.46	0.50	522	0.93
Prot							
Perm							
Thru	T	242	1906	0.13	0.50	953	0.25
Right							
Northbound							
Prot							
Perm							
Left	L	4	435	0.01	0.33	145	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	780	4802	# 0.16	0.33	1601	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.29	0.50	8.8	1.000	932	0.50	0.8	0.0	9.5	A	9.5	A
Westbound												
L	0.93	0.50	14.0	1.000	522	0.50	24.6	0.0	38.6	D		
T	0.25	0.50	8.6	1.000	953	0.50	0.6	0.0	9.2	A	28.8	C
Northbound												
L	0.03	0.33	13.5	1.000	145	0.50	0.4	0.0	13.8	B	13.8	B
Southbound												
LTR	0.49	0.33	15.9	1.000	1601	0.50	1.1	0.0	17.0	B	17.0	B

Intersection delay = 20.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		30.0	20.0	
Effective permitted green time for LT lane group, g(s)		30.0	20.0	
Opposing effective green time, go (s)		30.0	20.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		484	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.04	
Adjusted opposing flow rate, Vo (veh/h)		267	780	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		8.07	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		4.45	4.77	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50	0.67	
gq, (see Exhibit C16-4,5,6,7,8)		2.39	5.58	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		27.61	14.42	
n=Max(gq-gf)/2,0)		1.20	2.79	
PTHo=1-PLTo		1.00	0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.68	2.91	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.69	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.13	0.20	
gdifff=max(gq-gf,0)		0.00	5.58	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.55	0.25	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.547	0.248	

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.038
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 0.908
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	T	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	267		484	242	4			286	
So	1900		1900	1900	1900			1900	
No.Lanes	0 1 0		1 1 0		1 0 0			0 3 0	
SL	1863		1043	1906	435			1762	
LnCapacity	932		522	953	145			587	
Flow Ratio	0.1		0.5	0.1	0.0			0.2	
v/c Ratio	0.29		0.93	0.25	0.03			0.49	
Grn Ratio	0.50		0.50	0.50	0.33			0.33	
I Factor	1.000			0.981		0.998		1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	2.6		7.5	2.3	0.0			3.8	
kB	0.8		0.5	0.8	0.2			0.6	
Q2	0.3		3.8	0.3	0.0			0.6	
Q Average	2.9		11.3	2.6	0.1			4.3	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3			1.2	
BOQ	3.7		13.7	3.3	0.1			5.4	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.4	1.6	1.7			1.5	
BOQ	4.6		16.2	4.1	0.1			6.6	
QSRatio									
90th Percentile Output:									
fB%	1.8		1.6	1.8	2.0			1.7	
BOQ	5.2		17.6	4.7	0.1			7.4	
QSRatio									
95th Percentile Output:									
fB%	2.2		1.7	2.2	2.6			2.0	
BOQ	6.3		19.3	5.7	0.1			8.8	
QSRatio									
98th Percentile Output:									
fB%	2.5		1.9	2.6	3.2			2.3	
BOQ	7.4		21.0	6.7	0.2			10.1	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		166	243	465	163	90	199		472	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		11.5		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	10.0	15.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	273	1636	0.01	0.17	21.0	C	42.6	D
R	270	1620	0.78	0.17	43.0	D		
Westbound								
LTR	1164	4656	0.85	0.25	27.3	C	27.3	C
Northbound								
L	188	564	0.53	0.33	26.0	C		
T	575	1726	0.38	0.33	17.1	B	19.9	B
Southbound								
TR	1097	3290	0.59	0.33	17.3	B	17.3	B

Intersection Delay = 24.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		166	243	465	163	90	199		472	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		53	69	132	46	25	55		155	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			11.5	
RTOR Vol			0			0						0
Adj Flow	4		210		989		100	221			649	
%InSharedLn												
Prop LTS					0.279		1.000	0.000			0.000	
Prop RTS			1.000		0.187			0.000			0.043	
Peds Bikes	0	0		0	0					0	0	
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		10.0	15.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		166	243	465	163	90	199		472	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		210	276	528	185	100	221		621	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
Lane group	L		R			LTR	L		T			TR
Adj flow	4		210			989	100	221				649
Prop LTs						0.279	1.000	0.000				0.000
Prop RTs			1.000			0.187		0.000				0.043

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	1
fW	0.933	1.033	0.967	0.967	1.000	1.000	0.983	0.983
fHV	0.971	0.971	0.971	0.971	0.935	0.935	0.935	0.935
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.972	0.996	0.996
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	0.952	0.952
fRT		0.850	0.972	0.972		1.000	0.994	0.994
fLT	0.950		0.986	0.986	0.318	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1636	1620	4656	4656	564	1726	3290	3290
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.17	273	0.01
Prot							
Perm							
Thru							
Right	R	210	1620	# 0.13	0.17	270	0.78
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	989	4656	# 0.21	0.25	1164	0.85
Right							
Northbound							
Prot							
Perm							
Left	L	100	564	0.18	0.33	188	0.53
Prot							
Perm							
Thru	T	221	1726	0.13	0.33	575	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	649	3290	# 0.20	0.33	1097	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
L	0.01	0.17	20.9	1.000	273	0.50	0.1	0.0	21.0	C	42.6	D
R	0.78	0.17	23.9	1.000	270	0.50	19.1	0.0	43.0	D		
Westbound												
LTR	0.85	0.25	21.4	1.000	1164	0.50	5.8	0.0	27.3	C	27.3	C
Northbound												
L	0.53	0.33	16.2	1.000	188	0.50	9.8	0.0	26.0	C	19.9	B
T	0.38	0.33	15.3	1.000	575	0.50	1.8	0.0	17.1	B		
Southbound												
TR	0.59	0.33	16.6	1.000	1097	0.50	0.7	0.0	17.3	B	17.3	B

Intersection delay = 24.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			100	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			649	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			1.67	
Opposing lane util. factor, fLUo	0.908		0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.68	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			4.34	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.66	
n=Max(gq-gf)/2,0)			2.17	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.46	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.32	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.318	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.279 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.34	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.217	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			649	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	15.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	15.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.187	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	25.0	20.9	0.00	0.0	0.0	21.0
	0.0						0.0	
R	0.0	0.00	25.0	23.9	0.00	0.0	0.0	43.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	21.4	0.00	0.0	0.0	27.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.2	0.00	0.0	0.0	26.0
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.6	0.00	0.0	0.0	17.3
	0.0						0.0	

Intersection Delay	24.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	4	210	363	100	221	340
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	2 0
SL	1636	1620	1709	564	1726	1727
LnCapacity	273	270	427	188	575	576
Flow Ratio	0.0	0.1	0.2	0.2	0.1	0.2
v/c Ratio	0.01	0.78	0.85	0.53	0.38	0.59
Grn Ratio	0.17	0.17	0.25	0.33	0.33	0.33
I Factor	0.974		0.725	0.946		0.293
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	3.4	5.8	1.4	2.8	4.7
kB	0.3	0.3	0.3	0.3	0.6	0.2
Q2	0.0	1.0	1.6	0.3	0.3	0.2
Q Average	0.1	4.4	7.4	1.6	3.2	4.9
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.2	1.2	1.3	1.3	1.2
BOQ	0.1	5.4	9.0	2.1	4.0	6.1
QSRatio						
85th Percentile Output:						
fB%	1.7	1.5	1.5	1.6	1.6	1.5
BOQ	0.1	6.7	10.8	2.6	4.9	7.5
QSRatio						
90th Percentile Output:						
fB%	2.0	1.7	1.6	1.9	1.8	1.7
BOQ	0.1	7.5	11.9	3.0	5.6	8.3
QSRatio						
95th Percentile Output:						
fB%	2.6	2.0	1.8	2.3	2.1	2.0
BOQ	0.2	8.8	13.5	3.8	6.7	9.8
QSRatio						
98th Percentile Output:						
fB%	3.2	2.3	2.0	2.8	2.5	2.3
BOQ	0.2	10.2	15.1	4.5	7.9	11.2
QSRatio						

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/10 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	20	13	172	16	104	10	230	131	138	337	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	36.0				44.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 581 1452 0.10 0.40 17.3 B 17.3 B

Westbound

L 490 1224 0.40 0.40 21.6 C
 T 700 1749 0.03 0.40 16.4 B 20.3 C
 R 516 1291 0.23 0.40 18.8 B

Northbound

LTR 770 1576 0.54 0.49 18.2 B 18.2 B

Southbound

LTR 606 1239 1.05 0.49 50.6 D 50.6 D

Intersection Delay = 33.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/10
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	20	13	172	16	104	10	230	131	138	337	9
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	5	49	5	30	3	64	36	45	111	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		60		195	18	118		413			637	
%InSharedLn												
Prop LTs		0.200		1.000	0.000			0.027			0.286	
Prop RTs		0.317			0.000	1.000		0.354			0.019	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000				0.966		0.850			0.090		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5				11.8		18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		36.0						44.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	20	13	172	16	104	10	230	131	138	337	9
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	12	29	19	195	18	118	11	256	146	182	443	12
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	60			195	18	118	413			637		
Prop LTs	0.200			1.000	0.000		0.027			0.286		
Prop RTs	0.317			0.000 1.000			0.354			0.019		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.971			0.952	0.952	0.952	0.935			0.935		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	0.992			1.000	1.000	0.992	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.957				1.000	0.850	0.952			0.997		
fLT	0.967			0.718	1.000		0.982			0.705		
Sec.												
fLpb	1.000			0.942	1.000		1.000			0.993		
fRpb	0.980				1.000	1.000	0.982			1.000		
S	1452			1224	1749	1291	1576			1239		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1452	0.04	0.40	581	0.10
Right							
Westbound							
Prot							
Perm							
Left	L	195	1224	# 0.16	0.40	490	0.40
Prot							
Perm							
Thru	T	18	1749	0.01	0.40	700	0.03
Right	R	118	1291	0.09	0.40	516	0.23
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	413	1576	0.26	0.49	770	0.54
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	637	1239	# 0.51	0.49	606	1.05
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.67
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.10	0.40	16.9	1.000	581	0.50	0.4	0.0	17.3	B	17.3	B
Westbound												
L	0.40	0.40	19.3	1.000	490	0.50	2.3	0.0	21.6	C		
T	0.03	0.40	16.4	1.000	700	0.50	0.1	0.0	16.4	B	20.3	C
R	0.23	0.40	17.8	1.000	516	0.50	1.0	0.0	18.8	B		
Northbound												
LTR	0.54	0.49	15.9	1.000	770	0.50	2.3	0.0	18.2	B	18.2	B
Southbound												
LTR	1.05	0.49	23.0	1.000	606	0.50	27.6	0.0	50.6	D	50.6	D

Intersection delay = 33.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		36.0		
Effective permitted green time for LT lane group, g(s)		36.0		
Opposing effective green time, go (s)		36.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		195		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.20		
Adjusted opposing flow rate, Vo (veh/h)		60		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		4.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.50		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.60		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		36.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.80		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.11		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.718		

For special case of single-lane approach opposed by multilane approach,
see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	36.0		44.0	44.0
Effective permitted green time for LT lane group, g(s)	36.0		44.0	44.0
Opposing effective green time, go (s)	36.0		44.0	44.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	12	11	182	
Proportion of LT in LT lane group, PLT	0.200	0.000	0.027	0.286
Proportion of LT in opposing flow, PLTo	0.00		0.29	0.03
Adjusted opposing flow rate, Vo (veh/h)	18		637	413
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.30		0.28	4.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45		15.93	10.32
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.8		25.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.60		0.51	0.51
gq, (see Exhibit C16-4,5,6,7,8)	0.00		14.99	9.37
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.18		18.96	34.63
n=Max(gq-gf)/2,0)	0.00		0.00	4.68
PTHo=1-PLTo	1.00		0.71	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.20		0.03	0.29
EL1 (refer to Exhibit C16-3)	1.40		2.63	2.11
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	4.46
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		0.05	0.06
gdifff=max(gq-gf,0)	0.00		0.00	9.37
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97		0.98	0.70
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.967		0.982	0.705

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	36.0	36.0	44.0	44.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	125	0	102
OCCpedg	0.000	0.063	0.000	0.051
Opposing queue clearing green, gq (s)	0.00	0.00	14.99	9.37
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.341	0.213
OCCpedu	0.000	0.063	0.000	0.046
Opposing flow rate, Vo (veh/h)	18	60	637	413
OCCr	0.000	0.058	0.000	0.026
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.942	1.000	0.974
Proportion of left turns, PLT	0.200	1.000	0.027	0.286
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.942	1.000	0.993
Permitted Right Turns				
Effective pedestrian green time, gp (s)	36.0	36.0	44.0	44.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	125	0	102	0
OCCpedg	0.063	0.000	0.051	0.000
Effective green, g (s)	36.0	36.0	44.0	44.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.063	0.000	0.051	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.938	1.000	0.949	1.000
Proportion right-turns, PRT	0.317	1.000	0.354	0.019
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.980	1.000	0.982	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	27.0	16.9	0.00	0.0	0.0	17.3
	0.0						0.0	
Westbound								
L	0.0	0.00	27.0	19.3	0.00	0.0	0.0	21.6
T	0.0	0.00	27.0	16.4	0.00	0.0	0.0	16.4
R	0.0	0.00	27.0	17.8	0.00	0.0	0.0	18.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	23.0	15.9	0.00	0.0	0.0	18.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	23.0	23.0	0.00	7.7	0.0	50.6
	0.0						0.0	
Intersection Delay			33.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		60	195	18	118		413		637
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	1
SL		1452	1224	1749	1291		1576		1239
LnCapacity		581	490	700	516		770		606
Flow Ratio		0.0	0.2	0.0	0.1		0.3		0.5
v/c Ratio		0.10	0.40	0.03	0.23		0.54		1.05
Grn Ratio		0.40	0.40	0.40	0.40		0.49		0.49
I Factor		1.000		0.966			0.850		0.090
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.9	3.5	0.3	1.9		7.2		15.9
kB		0.8	0.7	0.9	0.7		0.8		0.1
Q2		0.1	0.4	0.0	0.2		0.9		5.0
Q Average		1.0	3.9	0.3	2.2		8.1		20.9
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		1.3	4.9	0.4	2.7		9.8		25.2
QSRatio									
85th Percentile Output:									
fB%		1.6	1.5	1.7	1.6		1.5		1.4
BOQ		1.7	6.0	0.5	3.4		11.8		29.4
QSRatio									
90th Percentile Output:									
fB%		1.9	1.7	2.0	1.8		1.6		1.5
BOQ		2.0	6.8	0.6	3.9		12.9		31.6
QSRatio									
95th Percentile Output:									
fB%		2.4	2.1	2.5	2.3		1.8		1.6
BOQ		2.5	8.1	0.8	4.8		14.5		33.8
QSRatio									
98th Percentile Output:									
fB%		2.9	2.4	3.1	2.7		2.0		1.7
BOQ		3.0	9.3	0.9	5.8		16.1		36.1
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	175	188		186	217		224		159			
Lane Width	16.0			10.0	10.0		11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left			
	Thru	P				Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	901	1801	0.39	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Westbound

L	364	727	0.57	0.50	22.1	C		
T	785	1569	0.31	0.50	14.3	B	17.9	B

Northbound

LR	526	1352	0.77	0.39	33.2	C	33.2	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 22.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		175	188	186	217		224		159			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		48	51	52	61		60		42			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		10.0	10.0			11.0				
RTOR Vol			44						0			
Adj Flow		347		209	244			407				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.585				
Prop RTs		0.452			0.000			0.415				
Peds Bikes		0						0		0		
Buses		5		0	0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		175	188	186	217		224		159			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		190	157	209	244		238		169			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		347		209	244			407				
Prop LTs		0.000		1.000	0.000			0.585				
Prop RTs		0.452			0.000			0.415				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.933 0.933		0.967			
fHV	0.909		0.885 0.885		0.917			
fG	1.000		1.000 1.000		1.000			
fP	1.000		1.000 1.000		0.875			
fBB	0.980		1.000 1.000		1.000			
fA	1.000		1.000 1.000		1.000			
fLU	1.000		1.000 1.000		1.000			
fRT	0.939		1.000		0.944			
fLT	1.000		0.463 1.000		0.972			
Sec.								
fLpb	1.000		1.000 1.000		1.000			
fRpb	1.000		1.000		1.000			
S	1801		727 1569		1352			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	347	1801	0.19	0.50	901	0.39
Right							
Westbound							
Prot							
Perm							
Left	L	209	727	# 0.29	0.50	364	0.57
Prot							
Perm							
Thru	T	244	1569	0.16	0.50	785	0.31
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	407	1352	# 0.30	0.39	526	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination

Eastbound												
TR	0.39	0.50	13.9	1.000	901	0.50	1.2	0.0	15.1	B	15.1	B
Westbound												
L	0.57	0.50	15.8	1.000	364	0.50	6.4	0.0	22.1	C		
T	0.31	0.50	13.3	1.000	785	0.50	1.0	0.0	14.3	B	17.9	B
Northbound												
LR	0.77	0.39	24.0	1.000	526	0.50	9.2	0.0	33.2	C	33.2	C
Southbound												

Intersection delay = 22.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		209		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		347		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		5.22		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.68		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		7.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		37.71		
n=Max(gq-gf)/2,0)		3.65		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.81		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.09		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.46		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.463		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.585
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
L	0.0	0.00	22.5	15.8	0.00	0.0	0.0	22.1
T	0.0	0.00	22.5	13.3	0.00	0.0	0.0	14.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	24.0	0.00	0.0	0.0	33.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			22.3	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	TR			L	T	LR					
Init Queue	0.0			0.0	0.0	0.0					
Flow Rate	347			209	244	407					
So	1900			1900	1900	1900					
No.Lanes	0	1	0	1	1	0	0	0	0	0	0
SL	1801			727	1569	1352					
LnCapacity	901			364	785	526					
Flow Ratio	0.2			0.3	0.2	0.3					
v/c Ratio	0.39			0.57	0.31	0.77					
Grn Ratio	0.50			0.50	0.50	0.39					
I Factor	0.964			0.986		0.858					
AT or PVG	3			3	3	3					
Pltn Ratio	1.00			1.00	1.00	1.00					
PF2	1.00			1.00	1.00	1.00					
Q1	5.4			3.7	3.6	8.9					
kB	1.0			0.6	1.0	0.6					
Q2	0.6			0.7	0.4	1.9					
Q Average	6.0			4.4	4.0	10.8					
Q Spacing	25.0			25.0	25.0	25.0					
Q Storage	0			0	0	0					
Q S Ratio											
70th Percentile Output:											
fB%	1.2			1.2	1.2	1.2					
BOQ	7.4			5.4	5.0	13.1					
QSRatio											
85th Percentile Output:											
fB%	1.5			1.5	1.5	1.4					
BOQ	9.0			6.7	6.2	15.5					
QSRatio											
90th Percentile Output:											
fB%	1.7			1.7	1.7	1.6					
BOQ	9.9			7.5	7.0	16.8					
QSRatio											
95th Percentile Output:											
fB%	1.9			2.0	2.0	1.7					
BOQ	11.4			8.8	8.3	18.5					
QSRatio											
98th Percentile Output:											
fB%	2.2			2.3	2.4	1.9					
BOQ	12.9			10.2	9.6	20.2					
QSRatio											

ERROR MESSAGES

No errors to report.

Weekday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			315	44		20	323	
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91	
Hourly Flow Rate, HFR			370	51		21	354	
Percent Heavy Vehicles			--	--		15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		148		16				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		157		17				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage					/			
Lanes		1		1				
Configuration		L		R				

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8		10	11
Lane Config		LT		L		R		12
v (vph)		21		157		17		
C(m) (vph)		1072		354		658		
v/c		0.02		0.44		0.03		
95% queue length		0.06		2.20		0.08		
Control Delay		8.4		23.0		10.6		
LOS		A		C		B		
Approach Delay					21.8			
Approach LOS					C			

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		315	44	20	323	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		93	13	5	89	
Hourly Flow Rate, HFR		370	51	21	354	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	148		16			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	39		4			
Hourly Flow Rate, HFR	157		17			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		354
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		421	792		396			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	396	
Potential Capacity	658	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	658	
Probability of Queue free St.	0.97	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	421	
Potential Capacity	1072	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1072	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.98	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.98	0.98
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	792	
Potential Capacity	361	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.98
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.96
Movement Capacity	354	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.98 0.98
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 792
Potential Capacity 361
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.98
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.96
Movement Capacity 354

Results for Two-stage process:
a
y
C t 354

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	157		17			
Movement Capacity (vph)	354		658			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	354		658			
Volume	157		17			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		21	157		17			
C(m) (vph)		1072	354		658			
v/c		0.02	0.44		0.03			
95% queue length		0.06	2.20		0.08			
Control Delay		8.4	23.0		10.6			
LOS		A	C		B			
Approach Delay				21.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(il), Volume for stream 2 or 5		354
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.98
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	1	17	6	299	24	397	1	174	285	241	191	1
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	712	1710	0.04	0.42	10.5	B	10.5	B
Westbound								
LT	521	1250	0.69	0.42	20.8	C	26.1	C
R	518	1244	0.85	0.42	30.3	C		
Northbound								
LT	704	1690	0.27	0.42	12.4	B	14.5	B
R	606	1455	0.51	0.42	15.8	B		
Southbound								
L	440	1057	0.64	0.42	20.8	C		
TR	703	1688	0.32	0.42	12.9	B	17.3	B

Intersection Delay = 20.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	299	24	397	1	174	285	241	191	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	83	7	110	1	47	77	70	56	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900	1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		28			359	441		190	310	280	223	
%InSharedLn												
Prop LTs		0.036			0.925			0.005		1.000	0.000	
Prop RTs		0.250			0.000	1.000		0.000	1.000		0.004	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		3	0	0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	299	24	397	1	174	285	241	191	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	332	27	441	1	189	310	280	222	1
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	28			359 441			190 310			280 223		
Prop LTs	0.036			0.925			0.005			1.000 0.000		
Prop RTs	0.250			0.000 1.000			0.000 1.000			0.004		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.962			0.943 0.943			0.901 0.901			0.935 0.935		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988 1.000			1.000 0.984		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.966			1.000 0.850			1.000 0.850			0.999		
fLT	0.992			0.722			0.999			0.638 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1710			1250 1244			1690 1455			1057 1688		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1710	0.02	0.42	712	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	359	1250	0.29	0.42	521	0.69
Right	R	441	1244	# 0.35	0.42	518	0.85
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	190	1690	0.11	0.42	704	0.27
Right	R	310	1455	0.21	0.42	606	0.51
Southbound							
Prot							
Perm							
Left	L	280	1057	# 0.26	0.42	440	0.64
Prot							
Perm							
Thru	TR	223	1688	0.13	0.42	703	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.42	10.4	1.000	712	0.50	0.1	0.0	10.5	B	10.5	B	
Westbound													
LT	0.69	0.42	14.3	1.000	521	0.50	6.5	0.0	20.8	C	26.1	C	
R	0.85	0.42	15.8	1.000	518	0.50	14.5	0.0	30.3	C			
Northbound													
LT	0.27	0.42	11.5	1.000	704	0.50	0.9	0.0	12.4	B	14.5	B	
R	0.51	0.42	13.0	1.000	606	0.50	2.9	0.0	15.8	B			
Southbound													
L	0.64	0.42	13.9	1.000	440	0.50	6.9	0.0	20.8	C			
TR	0.32	0.42	11.8	1.000	703	0.50	1.2	0.0	12.9	B	17.3	B	

Intersection delay = 20.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				280
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				190
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.17
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.57
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.16
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.64
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.638

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	332	1	
Proportion of LT in LT lane group, PLT	0.036	0.925	0.005	0.000
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.00	
Adjusted opposing flow rate, Vo (veh/h)	359	28	223	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.53	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.98	0.47	3.72	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	5.91	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.14	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.08	0.96	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.01	
EL1 (refer to Exhibit C16-3)	2.00	1.42	1.74	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.722	0.999	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.91		0.00	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.236		0.000	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	359		223	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.005	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	20.8
R	0.0	0.00	17.5	15.8	0.00	0.0	0.0	30.3
Northbound								
	0.0						0.0	
LT	0.0	0.00	17.5	11.5	0.00	0.0	0.0	12.4
R	0.0	0.00	17.5	13.0	0.00	0.0	0.0	15.8
Southbound								
L	0.0	0.00	17.5	13.9	0.00	0.0	0.0	20.8
TR	0.0	0.00	17.5	11.8	0.00	0.0	0.0	12.9
	0.0						0.0	

Intersection Delay	20.3	sec/veh	Intersection LOS	C
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	28		359	441	190	310	280	223
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	1 1	0
SL	1710		1250	1244	1690	1455	1057	1688
LnCapacity	712		521	518	704	606	440	703
Flow Ratio	0.0		0.3	0.4	0.1	0.2	0.3	0.1
v/c Ratio	0.04		0.69	0.85	0.27	0.51	0.64	0.32
Grn Ratio	0.42		0.42	0.42	0.42	0.42	0.42	0.42
I Factor	1.000		0.887		0.931			1.000
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3		4.9	6.6	2.1	3.8	3.7	2.5
kB	0.7		0.5	0.5	0.6	0.6	0.5	0.7
Q2	0.0		1.0	2.2	0.2	0.6	0.8	0.3
Q Average	0.3		5.9	8.9	2.3	4.4	4.5	2.8
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.3
BOQ	0.4		7.3	10.8	2.9	5.5	5.6	3.5
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.6	1.5	1.5	1.6
BOQ	0.5		8.8	12.9	3.7	6.7	6.9	4.4
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.6	1.8	1.7	1.7	1.8
BOQ	0.6		9.8	14.1	4.2	7.5	7.7	5.0
QSRatio								
95th Percentile Output:								
fB%	2.5		1.9	1.8	2.2	2.0	2.0	2.2
BOQ	0.8		11.3	15.7	5.2	8.9	9.1	6.1
QSRatio								
98th Percentile Output:								
fB%	3.1		2.2	2.0	2.6	2.3	2.3	2.6
BOQ	0.9		12.8	17.4	6.1	10.2	10.4	7.2
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				101		205	478	79		192	471	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 385 1444 0.91 0.27 48.8 D 48.8 D

Northbound

TR 1059 1868 0.57 0.57 10.3 B 10.3 B

Southbound

L 329 581 0.68 0.57 14.7 B
 T 933 1646 0.59 0.57 9.8 A 11.2 B

Intersection Delay = 18.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				101		205	478	79		192	471	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				29		59	130	21		56	137	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					352			606		223	548	
%InSharedLn												
Prop LTs					0.330			0.000		1.000	0.000	
Prop RTs					0.670			0.142		0.000		
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.944			0.880				0.500	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				101		205	478	79		192	471	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				116		236	520	86		223	548	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group				LR			TR			L T		
Adj flow					352			606		223	548	
Prop LTs					0.330			0.000		1.000	0.000	
Prop RTs					0.670			0.142			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound				Westbound			Northbound		Southbound	
LG					LR			TR		L	T
So					1900			1900		1900	1900
Lanes	0	0	0	0	0	0	0	1	0	1	1
fW					1.000			1.100		0.933	0.933
fHV					0.971			0.926		0.943	0.943
fG					1.000			1.000		1.000	1.000
fP					0.875			1.000		1.000	1.000
fBB					1.000			0.984		1.000	0.984
fA					1.000			1.000		1.000	1.000
FLU					1.000			1.000		1.000	1.000
fRT					0.909			0.981			1.000
fLT					0.984			1.000		0.348	1.000
Sec.											
fLpb					1.000			1.000		1.000	1.000
fRpb					1.000			1.000			1.000
S					1444			1868		581	1646
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	352	1444	# 0.24	0.27	385	0.91
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	606	1868	0.32	0.57	1059	0.57
Right							
Southbound							
Prot							
Perm							
Left	L	223	581	# 0.38	0.57	329	0.68
Prot							
Perm							
Thru	T	548	1646	0.33	0.57	933	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.91	0.27	21.3	1.000	385	0.50	27.5	0.0	48.8	D	48.8	D
Northbound												
TR	0.57	0.57	8.3	1.000	1059	0.50	2.0	0.0	10.3	B	10.3	B
Southbound												
L	0.68	0.57	9.1	1.000	329	0.50	5.5	0.0	14.7	B		
T	0.59	0.57	8.4	1.000	933	0.50	1.4	0.0	9.8	A	11.2	B

Intersection delay = 18.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				223
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				606
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.72
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				10.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				6.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.14
n=Max(gq-gf)/2,0)				3.43
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/h				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.35
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.348

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.330 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.202
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				606
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.670	0.142
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.3	0.00	0.0	0.0	48.8
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	9.1	0.00	0.0	0.0	14.7
T	0.0	0.00	13.0	8.4	0.00	0.0	0.0	9.8
	0.0						0.0	
Intersection Delay			18.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					352		606	223	548
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1444		1868	581	1646
LnCapacity					385		1059	329	933
Flow Ratio					0.2		0.3	0.4	0.3
v/c Ratio					0.91		0.57	0.68	0.59
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.944		0.880		0.500
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					5.7		6.5	2.6	5.9
kB					0.4		0.8	0.2	0.4
Q2					2.7		1.0	0.4	0.6
Q Average					8.4		7.5	3.0	6.5
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					10.2		9.2	3.8	8.0
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5	1.6	1.5
BOQ					12.2		11.0	4.7	9.6
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.8	1.6
BOQ					13.4		12.1	5.4	10.6
QSRatio									
95th Percentile Output:									
fB%					1.8		1.8	2.1	1.9
BOQ					15.0		13.7	6.5	12.2
QSRatio									
98th Percentile Output:									
fB%					2.0		2.0	2.5	2.1
BOQ					16.6		15.3	7.6	13.7
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 FULL Mititgation
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	149	326	152	215	600	84	157	326	223	149	67	89
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P	P			SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right		P			EB Right			
SB Right					WB Right			
Green	24.0	6.0			22.0	20.0		
Yellow	3.0	3.0			3.0	3.0		
All Red	0.0	2.0			2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	292	1728	0.61	0.37	41.4	D		
T	502	1881	0.77	0.27	40.0	D	38.1	D
R	398	1492	0.36	0.27	28.9	C		
Westbound								
L	282	1589	0.85	0.37	59.4	E		
TR	896	3359	0.83	0.27	39.4	D	44.3	D
Northbound								
LT	851	3480	0.61	0.24	33.5	C	30.6	C
R	531	1449	0.45	0.37	24.4	C		
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	353	1590	0.55	0.22	37.1	D	36.0	D

Intersection Delay = 38.0 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mititgation
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	326	152	215	600	84	157	326	223	149	67	89
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	97	45	60	167	23	42	88	60	47	21	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	177	388	143	239	746			520	240	186	195	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.325			0.000	
Prop RTS		0.000	1.000		0.106			0.000	1.000		0.569	
Peds Bikes	0			0	0	0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase	0.0			0.0								
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.856			0.927			1.000			0.985	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P	P			SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right		P			EB	Right		
SB	Right					WB	Right		
Green		24.0	6.0				22.0	20.0	
Yellow		3.0	3.0				3.0	3.0	
All Red		0.0	2.0				2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	326	152	215	600	84	157	326	223	149	67	89
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	177	388	143	239	667	79	169	351	240	186	84	111
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	177	388	143	239	746			520	240	186	195	
Prop LTs	1.000	0.000		1.000	0.000			0.325			0.000	
Prop RTs		0.000	1.000		0.106			0.000	1.000		0.569	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.943	0.943		0.962	0.962		0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.984		1.000	0.850			0.915	
fLT	0.950	1.000		0.950	1.000		0.984			0.950	1.000	
Sec.	0.182			0.214								
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	1728	1881	1492	1589	3359		3480	1449		1711	1590	
Sec.	331			359								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		96	1728	0.06	0.122	211	0.45
Perm		81	331	0.24	0.244	81	1.00
Left	L	177			0.37	292	0.61
Prot							
Perm							
Thru	T	388	1881	0.21	0.27	502	0.77
Right	R	143	1492	0.10	0.27	398	0.36
Westbound							
Prot		151	1589	# 0.10	0.122	194	0.78
Perm		88	359	# 0.25	0.244	88	1.00
Left	L	239			0.37	282	0.85
Prot							
Perm							
Thru	TR	746	3359	0.22	0.27	896	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	520	3480	# 0.15	0.24	851	0.61
Right	R	240	1449	0.17	0.37	531	0.45
Southbound							
Prot							
Perm							
Left	L	186	1711	0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	195	1590	# 0.12	0.22	353	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.61	0.37	33.6	1.000	292	0.50	7.8	0.0	41.4	D		
T	0.77	0.27	30.5	1.000	502	0.50	9.6	0.0	40.0	D	38.1	D
R	0.36	0.27	26.8	1.000	398	0.50	2.2	0.0	28.9	C		
Westbound												
L	0.85	0.37	35.1	1.000	282	0.50	24.3	0.0	59.4	E		
TR	0.83	0.27	31.1	1.000	896	0.50	8.3	0.0	39.4	D	44.3	D
Northbound												
LT	0.61	0.24	30.2	1.000	851	0.50	3.3	0.0	33.5	C	30.6	C
R	0.45	0.37	21.6	1.000	531	0.50	2.8	0.0	24.4	C		
Southbound												
L	0.49	0.22	30.5	1.000	380	0.50	4.4	0.0	34.9	C		
TR	0.55	0.22	31.0	1.000	353	0.50	6.0	0.0	37.1	D	36.0	D

Intersection delay = 38.0 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	33.0	33.0		
Effective permitted green time for LT lane group, g(s)	22.0	22.0		
Opposing effective green time, go (s)	24.0	24.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	177	239		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	746	388		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.43	5.98		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.80	9.70		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73	0.73		
gq, (see Exhibit C16-4,5,6,7,8)	13.36	13.14		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.64	8.86		
n=Max(gq-gf)/2,0)	6.68	6.57		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.71	1.88		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.18	0.18		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.18	0.21		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.182	0.214		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.325 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	24.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	13.36			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.557			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	746			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		24.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		24.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	177	239		
v/c ratio from Capacity Worksheet, X	0.61	0.85		
Protected phase effective green interval, g (s)	11.0	11.0		
Opposing queue effective green interval, gq	13.36	13.14		
Unopposed green interval, gu	8.64	8.86		
Red time r=(C-g-gq-gu)	57.0	57.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.07		
Protected ph. departure rate, Sp=s/3600	0.480	0.441		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.23	0.25		
XPerm	1.92	2.39		
XProt				
Case	5	5		
Queue at beginning of green arrow, Qa	1.86	3.05		
Queue at beginning of unsaturated green, Qu	3.46	4.66		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	33.6	35.1		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		33.6	0.00	0.0	0.0	41.4
T	0.0	0.00	33.0	30.5	0.00	0.0	0.0	40.0
R	0.0	0.00	33.0	26.8	0.00	0.0	0.0	28.9
Westbound								
L	0.0	0.00		35.1	0.00	0.0	0.0	59.4
TR	0.0	0.00	33.0	31.1	0.00	0.0	0.0	39.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	34.0	30.2	0.00	0.0	0.0	33.5
R	0.0	0.00	28.5	21.6	0.00	0.0	0.0	24.4
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	31.0	0.00	0.0	0.0	37.1
	0.0						0.0	

Intersection Delay	38.0	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	TR		LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	177	388	143	239	391		273	240	186	195
So	1900	1900	1900	1900	1900		1900	1900	1900	1900
No.Lanes	1	1	1	1	2	0	2	1	1	0
SL	797	1881	1492	769	1764		1827	1449	1711	1590
LnCapacity	292	502	398	282	470		446	531	380	353
Flow Ratio	0.2	0.2	0.1	0.3	0.2		0.1	0.2	0.1	0.1
v/c Ratio	0.61	0.77	0.36	0.85	0.83		0.61	0.45	0.49	0.55
Grn Ratio	0.37	0.27	0.27	0.37	0.27		0.24	0.37	0.22	0.22
I Factor		0.856			0.927		1.000			0.985
AT or PVG	3	3	3	3	3		3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Q1	3.0	9.0	2.9	4.2	9.2		6.1	4.6	4.1	4.3
kB	0.4	0.6	0.5	0.4	0.6		0.6	0.7	0.6	0.5
Q2	0.6	1.8	0.3	1.8	2.5		1.0	0.6	0.5	0.6
Q Average	3.6	10.8	3.2	6.0	11.7		7.0	5.2	4.6	5.0
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2	1.3	1.2	1.2		1.2	1.2	1.2	1.2
BOQ	4.5	13.1	4.0	7.4	14.1		8.6	6.4	5.7	6.1
QSRatio										
85th Percentile Output:										
fB%	1.5	1.4	1.6	1.5	1.4		1.5	1.5	1.5	1.5
BOQ	5.6	15.5	5.0	9.0	16.7		10.4	7.8	7.0	7.5
QSRatio										
90th Percentile Output:										
fB%	1.7	1.6	1.8	1.6	1.5		1.6	1.7	1.7	1.7
BOQ	6.3	16.8	5.6	10.0	18.1		11.4	8.6	7.8	8.4
QSRatio										
95th Percentile Output:										
fB%	2.1	1.7	2.1	1.9	1.7		1.8	2.0	2.0	2.0
BOQ	7.6	18.5	6.8	11.5	19.8		13.0	10.1	9.2	9.8
QSRatio										
98th Percentile Output:										
fB%	2.4	1.9	2.5	2.1	1.8		2.1	2.2	2.3	2.3
BOQ	8.8	20.2	7.9	13.0	21.6		14.6	11.5	10.6	11.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: ML Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 08/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	62	133	476	225	382	18	296	200	88	23	527	225
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0	13.0			29.0	8.0		
Yellow	3.0	3.0			3.0	3.0		
All Red	0.0	2.0			0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	195	731	0.38	0.27	31.9	C		
TR	835	3131	0.87	0.27	42.2	D	41.2	D
Westbound								
DefL	432	1752	0.58	0.44	34.1	C		
TR	814	1832	0.55	0.44	20.8	C	25.6	C
Northbound								
DefL	350	1811	0.97	0.44	76.5	E		
TR	808	1819	0.41	0.44	18.5	B	47.9	D
Southbound								
L	256	795	0.10	0.32	22.2	C		
TR	911	2828	0.92	0.32	44.9	D	44.2	D

Intersection Delay = 40.0 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/19/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	133	476	225	382	18	296	200	88	23	527	225
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	40	142	63	106	5	85	57	25	6	146	63
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	74	725		250	444		340	331		26	836	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.782			0.045			0.305			0.299	
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0			0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P	P			SB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		24.0	13.0					29.0	8.0
Yellow		3.0	3.0					3.0	3.0
All Red		0.0	2.0					0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	133	476	225	382	18	296	200	88	23	527	225
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	74	158	567	250	424	20	340	230	101	26	586	250
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	74	725		250	444		340	331		26	836	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.782			0.045			0.305			0.299		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.933	1.000		1.000	1.000		1.033	1.033		0.900	0.917	
fHV	0.980	0.980		0.971	0.971		0.971	0.971		0.893	0.893	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.883			0.993			0.954			0.955	
fLT	0.421	1.000		0.950	1.000		0.950	1.000		0.521	1.000	
Sec.				0.182			0.154					
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	731	3131		1752	1832		1811	1819		795	2828	
Sec.				335			294					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	74	731	0.10	0.27	195	0.38
Prot							
Perm							
Thru	TR	725	3131	0.23	0.27	835	0.87
Right							
Westbound							
Prot		168	1752	0.10	0.200	350	0.48
Perm		82	335	# 0.24	0.244	82	1.00
Left	DefL	250			0.44	432	0.58
Prot							
Perm							
Thru	TR	444	1832	# 0.24	0.44	814	0.55
Right							
Northbound							
Prot		252	1811	0.14	0.144	262	0.96
Perm		88	294	0.30	0.300	88	1.00
Left	DefL	340			0.44	350	0.97
Prot							
Perm				#			
Thru	TR	331	1819	# 0.18	0.44	808	0.41
Right							
Southbound							
Prot							
Perm							
Left	L	26	795	0.03	0.32	256	0.10
Prot							
Perm							
Thru	TR	836	2828	0.30	0.32	911	0.92
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.97
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.25

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.38	0.27	26.9	1.000	195	0.50	4.9	0.0	31.9	C		
TR	0.87	0.27	31.5	1.000	835	0.50	10.7	0.0	42.2	D	41.2	D
Westbound												
DefL	0.58	0.44	28.9	1.000	432	0.50	5.2	0.0	34.1	C		
TR	0.55	0.44	18.3	1.000	814	0.50	2.4	0.0	20.8	C	25.6	C
Northbound												
DefL	0.97	0.44	35.0	1.000	350	0.50	41.4	0.0	76.5	E		
TR	0.41	0.44	17.0	1.000	808	0.50	1.5	0.0	18.5	B	47.9	D
Southbound												
L	0.10	0.32	21.4	1.000	256	0.50	0.8	0.0	22.2	C		
TR	0.92	0.32	29.4	1.000	911	0.50	15.5	0.0	44.9	D	44.2	D

Intersection delay = 40.0 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	24.0	40.0	40.0	29.0
Effective permitted green time for LT lane group, g(s)	24.0	22.0	27.0	29.0
Opposing effective green time, go (s)	40.0	24.0	29.0	40.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	74	250	340	26
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	444	725	836	331
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.85	6.25	8.50	0.65
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.55	9.52	10.98	4.14
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.73	0.68	0.56
gq, (see Exhibit C16-4,5,6,7,8)	4.03	12.71	14.68	2.06
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.97	9.29	12.32	26.94
n=Max(gq-gf)/2,0)	2.02	6.35	7.34	1.03
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	1.98	2.65	2.96	1.78
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.17	0.18	0.15	0.14
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.42	0.18	0.15	0.52
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.421	0.182	0.154	0.521

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	24.0	24.0		29.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	4.03	12.71		2.06
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.168	0.529		0.071
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	444	725		331
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	1.000		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	24.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	24.0	40.0	40.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.782	0.045	0.305
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	250	340		
v/c ratio from Capacity Worksheet, X	0.58	0.97		
Protected phase effective green interval, g (s)	18.0	13.0		
Opposing queue effective green interval, gq	12.71	14.68		
Unopposed green interval, gu	9.29	12.32		
Red time r=(C-g-gq-gu)	50.0	50.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.09		
Protected ph. departure rate, Sp=s/3600	0.487	0.503		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22	0.18		
XPerm	2.44	3.30		
XProt				
Case	5	5		
Queue at beginning of green arrow, Qa	2.95	5.07		
Queue at beginning of unsaturated green, Qu	4.35	6.11		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	28.9	35.0		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	33.0	26.9	0.00	0.0	0.0	31.9
TR	0.0	0.00	33.0	31.5	0.00	0.0	0.0	42.2
	0.0						0.0	
Westbound								
DefL	0.0	0.00		28.9	0.00	0.0	0.0	34.1
TR	0.0	0.00	25.0	18.3	0.00	0.0	0.0	20.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00		35.0	0.00	0.0	0.0	76.5
TR	0.0	0.00	25.0	17.0	0.00	0.0	0.0	18.5
	0.0						0.0	
Southbound								
L	0.0	0.00	30.5	21.4	0.00	0.0	0.0	22.2
TR	0.0	0.00	30.5	29.4	0.00	0.0	0.0	44.9
	0.0						0.0	

Intersection Delay 40.0 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	74	380		250	444		340	331		26	439	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	731	1644		973	1832		787	1819		795	1485	
LnCapacity	195	438		432	814		350	808		256	478	
Flow Ratio	0.1	0.2		0.3	0.2		0.4	0.2		0.0	0.3	
v/c Ratio	0.38	0.87		0.58	0.55		0.97	0.41		0.10	0.92	
Grn Ratio	0.27	0.27		0.44	0.44		0.44	0.44		0.32	0.32	
I Factor		0.889			0.932			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	1.5	9.1		3.9	8.1		5.5	5.6		0.5	10.6	
kB	0.3	0.6		0.6	0.9		0.5	1.0		0.4	0.7	
Q2	0.2	2.7		0.8	1.1		4.2	0.7		0.0	4.1	
Q Average	1.7	11.8		4.7	9.2		9.7	6.3		0.5	14.7	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	2.2	14.2		5.8	11.2		11.8	7.7		0.7	17.7	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.5	1.4		1.4	1.5		1.7	1.4	
BOQ	2.8	16.8		7.1	13.3		14.0	9.4		0.8	20.8	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5		1.7	1.6		1.6	1.6		2.0	1.5	
BOQ	3.2	18.2		8.0	14.6		15.3	10.3		1.0	22.5	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.7		2.0	1.8		1.7	1.9		2.5	1.7	
BOQ	3.9	20.0		9.4	16.2		17.0	11.9		1.3	24.3	
QSRatio												
98th Percentile Output:												
fB%	2.8	1.8		2.3	1.9		1.9	2.1		3.1	1.8	
BOQ	4.7	21.7		10.8	17.9		18.6	13.4		1.5	26.2	
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 6 < minimum green time for peds.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/29/2013	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Period	Year : 2020 FULL Mitigation
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L		TR		LT	R			LTR	L		LT R
Volume	678	430	3	1	449	796	0	0	1	125	0	136
Lane Width	11.0	12.0			12.0	12.0			16.0	10.0	11.0	10.0
RTOR Vol			0			0			0			0

		Signal Operations								
Phase	Combination	1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds			
WB	Left		P			SB	Left	P		
	Thru		P				Thru	P		
	Right	P	P				Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right	P		
Green		36.0	23.0					16.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Intersection Performance Summary								
Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	764	1711	0.98	0.71	43.6	D		
TR	1158	1628	0.41	0.71	6.1	A	29.0	C
Westbound								
LT	471	1843	1.03	0.26	71.4	E	25.9	C
R	1568	1568	0.56	1.00	0.8	A		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.55	0.18	42.9	D		
LT	320	1801	0.00	0.18	30.4	C	24.2	C
R	936	1478	0.15	0.63	7.0	A		
Intersection Delay = 27.1 (sec/veh) Intersection LOS = C								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	678	430	3	1	449	796	0	0	1	125	0	136
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	186	118	1	1	121	219	0	0	1	32	0	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	745	476			484	875		4		129	0	140
%InSharedLn										0		
Prop LTS	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTS		0.006			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		36.0	23.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	678	430	3		1	449	796		0	0	1		125	0	136
PHF	0.91	0.91	0.91		0.91	0.93	0.91		0.25	0.25	0.25		0.97	0.97	0.97
Adj flow	745	473	3		1	483	875		0	0	4		129	0	140
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	745	476				484	875			4			129	0	140
Prop LTs	1.000	0.000				0.002				0.000			1.000	0.000	
Prop RTs		0.006				0.000	1.000			1.000				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.980	0.980			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.999			1.000	0.850			0.865					1.000	0.850
fLT	0.950	1.000			0.999				1.000				0.755	1.000	
Sec.	0.143														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1711	1628			1843	1568			1844				1313	1801	1478
Sec.	257														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		684	1711	# 0.40	0.400	684	1.00
Perm		61	257	0.24	0.311	80	0.76
Left	L	745			0.71	764	0.98
Prot							
Perm							
Thru	TR	476	1628	0.29	0.71	1158	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1843	# 0.26	0.26	471	1.03
Right	R	875	1568	0.56	1.00	1568	0.56
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	129	1313	# 0.10	0.18	233	0.55
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	140	1478	0.09	0.63	936	0.15

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.76
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.91

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.98	0.71	21.1	1.000	764	0.50	22.5	0.0	43.6	D			
TR	0.41	0.71	5.3	1.000	1158	0.50	0.8	0.0	6.1	A	29.0	C	
Westbound													
LT	1.03	0.26	33.5	1.000	471	0.50	37.9	0.0	71.4	E	25.9	C	
R	0.56	1.00	0.0	0.950	1568	0.50	0.8	0.0	0.8	A			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.55	0.18	33.7	1.000	233	0.50	9.2	0.0	42.9	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	24.2	C	

R 0.15 0.63 6.7 1.000 936 0.50 0.3 0.0 7.0 A

Intersection delay = 27.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	28.0			16.0
Opposing effective green time, go (s)	23.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	745			129
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	484			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.63			3.23
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.10			0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.74			0.82
gq, (see Exhibit C16-4,5,6,7,8)	24.64			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	3.36			16.00
n=Max(gq-gf)/2,0)	12.32			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.05			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	12.18			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14			0.25
gdiff=max(gq-gf,0)	24.64			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.143			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		23.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		23.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	476	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.00	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.90	0.00	0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.6	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.40	16.00	16.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	0.00
EL1 (refer to Exhibit C16-3)	2.25	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09	0.13	0.13
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.999	1.000	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		23.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		476		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.006
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	745			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	36.0			
Opposing queue effective green interval, gq	20.64			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	29.4			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.51			
XPerm	2.50			
XProt	0.79			
Case	3			
Queue at beginning of green arrow, Qa	9.13			
Queue at beginning of unsaturated green, Qu	4.27			
Residual queue, Qr	3.06			
Uniform Delay, d1	21.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.1	0.00	0.0	0.0	43.6
TR	0.0	0.00	13.0	5.3	0.00	0.0	0.0	6.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	33.5	33.5	0.00	3.3	0.0	71.4
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.9
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.5	6.7	0.00	0.0	0.0	7.0

Intersection Delay	27.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	745	476		484	875	4		129	0	140
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1075	1628		1843	1568	1844		1313	1801	1478
LnCapacity	764	1158		471	1568	328		233	320	936
Flow Ratio	0.7	0.3		0.3	0.6	0.0		0.1	0.0	0.1
v/c Ratio	0.98	0.41		1.03	0.56	0.01		0.55	0.00	0.15
Grn Ratio	0.71	0.71		0.26	1.00	0.18		0.18	0.18	0.63
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	8.8	4.9		12.1		0.1		2.9	0.0	1.4
kB	0.7	0.9		0.4	0.9	0.5		0.4	0.5	1.1
Q2	6.9	0.6		5.6	1.1	0.0		0.5	0.0	0.2
Q Average	15.8	5.5		17.7		0.1		3.4	0.0	1.6
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2		1.3		1.3	1.3	1.3
BOQ	19.0	6.8		21.3		0.1		4.3	0.0	2.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4		1.7		1.6	1.7	1.6
BOQ	22.3	8.3		24.9		0.2		5.3	0.0	2.6
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5		2.0		1.8	2.0	1.9
BOQ	24.0	9.2		26.8		0.2		6.0	0.0	3.0
QSRatio										
95th Percentile Output:										
fB%	1.6	1.9		1.6		2.6		2.1	2.6	2.3
BOQ	25.9	10.6		28.8		0.2		7.2	0.0	3.7
QSRatio										
98th Percentile Output:										
fB%	1.8	2.2		1.7		3.2		2.5	3.2	2.8
BOQ	27.8	12.1		30.9		0.3		8.4	0.0	4.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 10/7/13	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2020 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	819	2006	0.70	0.50	23.5	C		
TR	1056	2111	0.04	0.50	11.5	B	22.7	C

LTR	1024	3071	0.13	0.33	21.1	C	21.1	C
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Northbound								
DefL	517	1329	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	539	1386	0.14	0.39	18.3	B	72.5	E
R	881	1524	1.09	0.58	76.9	E		

Intersection Delay = 51.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	519	38	0	2	64	71	4	3	0	64	6	1178	
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6	
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90	
PK 15 Vol	143	10	0	1	18	20	2	1	0	18	2	327	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900		1900	1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0	
RTOR Vol			0			17			0			310	
Adj Flow	570	42			131		7	5			78	964	
%InSharedLn													
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910		
Prop RTs		0.000			0.450			0.000			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0		0	0			0	0	
%InProtPhase	0.0		0.0									0.0	
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	519	38	0	2	64	71	4	3	0	64	6	1178
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	570	42	0	2	70	59	7	5	0	71	7	964
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	570	42			131		7	5			78	964
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	DefL	TR	LTR		DefL	TR	LT	R
So	1900	1900	1900		1900	1900	1900	1900
Lanes	0	2	0	0	2	0	0	1
fW	1.133	1.133	0.983		1.000	1.000	1.000	1.000
fHV	0.980	0.980	0.971		0.990	0.990	0.943	0.943
fG	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.952		1.000	1.000	1.000	1.000
fRT		1.000	0.932			1.000	1.000	0.850
fLT	0.950	1.000	0.954		0.706	1.000	0.773	
Sec.	0.669							
fLpb	1.000	1.000	1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	1.000
S	2006	2111	3071		1329	1881	1386	1524
Sec.	1413							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	130	2006	0.06	0.189	379	0.34
Perm		440	1413	# 0.31	0.311	440	1.00
Left		570			0.50	819	0.70
Prot	TR	42	2111	0.02	0.50	1056	0.04
Perm							
Thru							
Right	LTR	131	3071	0.04	0.33	1024	0.13
Prot							
Perm							
Left	DefL	7	1329	0.01	0.39	517	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Prot							
Perm	LT	78	1386	0.06	0.39	539	0.14
Left							
Prot							
Perm	R	964	1524	# 0.63	0.58	881	1.09
Thru							
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.94
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.70	0.50	18.8	1.000	819	0.50	4.7	0.0	23.5	C		
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	22.7	C
Westbound												
LTR	0.13	0.33	20.9	1.000	1024	0.50	0.3	0.0	21.1	C	21.1	C
Northbound												
DefL	0.01	0.39	16.9	1.000	517	0.50	0.0	0.0	16.9	B		
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.14	0.39	17.8	1.000	539	0.50	0.5	0.0	18.3	B	72.5	E

R 1.09 0.58 19.0 1.000 881 0.50 57.9 0.0 76.9 E

Intersection delay = 51.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	28.0		35.0	
Opposing effective green time, go (s)	30.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	570		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	131		78	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/3600	14.25		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.72		1.95	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.42	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.669		0.706	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		30.0		35.0
Effective permitted green time for LT lane group, g(s)		30.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	71
Proportion of LT in LT lane group, PLT	0.000	0.015 0.000 0.910
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	42	5
Lost time for LT lane group, tL	3.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.78
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.52	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.1	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	5.93	30.75
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	131	42	78	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.015	1.000	0.910
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	28.0	30.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.450	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	570			
v/c ratio from Capacity Worksheet, X	0.70			
Protected phase effective green interval, g (s)	17.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	28.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.16			
Protected ph. departure rate, Sp=s/3600	0.557			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.39			
XPerm	1.05			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	0.57			
Queue at beginning of unsaturated green, Qu	7.13			
Residual queue, Qr	0.00			
Uniform Delay, d1	18.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00		18.8	0.00	0.0	0.0	23.5
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	30.0	20.9	0.00	0.0	0.0	21.1
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	19.0	19.0	0.00	20.7	0.0	76.9
Intersection Delay			51.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	570	42			68		7	5		78	964	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1637	2111			1612		1329	1881		1386	1524	
LnCapacity	819	1056			537		517	732		539	881	
Flow Ratio	0.3	0.0			0.0		0.0	0.0		0.1	0.6	
v/c Ratio	0.70	0.04			0.13		0.01	0.01		0.14	1.09	
Grn Ratio	0.50	0.50			0.33		0.39	0.39		0.39	0.58	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	8.2	0.5			1.2		0.1	0.1		1.3	24.1	
kB	1.0	1.1			0.7		0.7	0.9		0.7	0.9	
Q2	2.1	0.0			0.1		0.0	0.0		0.1	17.0	
Q Average	10.3	0.6			1.3		0.1	0.1		1.4	41.1	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	12.4	0.8			1.6		0.2	0.1		1.8	49.3	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	14.8	1.0			2.1		0.2	0.1		2.2	57.5	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	16.0	1.1			2.4		0.2	0.2		2.6	61.6	
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.4		2.6	2.6		2.4	1.6	
BOQ	17.7	1.5			3.1		0.3	0.2		3.2	65.7	
QSRatio												
98th Percentile Output:												
fB%	1.9	3.0			2.9		3.2	3.2		2.8	1.7	
BOQ	19.4	1.8			3.7		0.4	0.3		3.9	69.8	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	38	0		550	83		1			23	666	34
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	29.0				21.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	909	1881	0.17	0.48	9.1	A	9.1	A
----	-----	------	------	------	-----	---	-----	---

Westbound

L	621	1284	0.93	0.48	37.1	D		
T	940	1944	0.09	0.48	8.6	A	33.4	C

Northbound

L	128	367	0.01	0.35	12.8	B	12.8	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	1702	4863	0.53	0.35	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 22.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		38	0	550	83		1			23	666	34
% Heavy Veh		1	1	1	1		1			2	2	2
PHF		0.25	0.25	0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol		38	0	145	22		1			7	208	11
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		152		579	87		1				903	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.032	
Prop RTs		0.000			0.000						0.047	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.983			0.989		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		29.0							21.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	38	0		550	83		1			23	666	34
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	152	0		579	87		1			29	832	42
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	152			579	87		1			903		
Prop LTs	0.000			1.000	0.000		1.000			0.032		
Prop RTs	0.000			0.000						0.047		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.993	
fLT	1.000		0.660 1.000		0.209		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1284 1944		367		4863	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	152	1881	0.08	0.48	909	0.17
Right							
Westbound							
Prot							
Perm							
Left	L	579	1284	# 0.45	0.48	621	0.93
Prot							
Perm							
Thru	T	87	1944	0.04	0.48	940	0.09
Right							
Northbound							
Prot							
Perm							
Left	L	1	367	0.00	0.35	128	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	903	4863	# 0.19	0.35	1702	0.53
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.17	0.48	8.7	1.000	909	0.50	0.4	0.0	9.1	A	9.1	A
Westbound												
L	0.93	0.48	14.6	1.000	621	0.50	22.6	0.0	37.1	D		
T	0.09	0.48	8.4	1.000	940	0.50	0.2	0.0	8.6	A	33.4	C
Northbound												
L	0.01	0.35	12.7	1.000	128	0.50	0.1	0.0	12.8	B	12.8	B
Southbound												
LTR	0.53	0.35	15.6	1.000	1702	0.50	1.2	0.0	16.8	B	16.8	B

Intersection delay = 22.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		29.0	21.0	
Effective permitted green time for LT lane group, g(s)		29.0	21.0	
Opposing effective green time, go (s)		29.0	21.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		579	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		152	903	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/3600		9.65	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		2.53	5.52	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.52	0.65	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	6.51	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		29.00	14.49	
n=Max(gq-gf)/2,0)		0.00	3.26	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.51	3.30	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.14	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.14	0.19	
gdifff=max(gq-gf,0)		0.00	6.51	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.66	0.21	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.660	0.209	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.032
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 0.908
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	T	L	LTR			
Init Queue	0.0		0.0	0.0	0.0	0.0			
Flow Rate	152		579	87	1	331			
So	1900		1900	1900	1900	1900			
No.Lanes	0	1	0	1	0	0	0	0	3
SL	1881		1284	1944	367	1785			
LnCapacity	909		621	940	128	624			
Flow Ratio	0.1		0.5	0.0	0.0	0.2			
v/c Ratio	0.17		0.93	0.09	0.01	0.53			
Grn Ratio	0.48		0.48	0.48	0.35	0.35			
I Factor	1.000		0.983		0.989			1.000	
AT or PVG	3		3	3	3	3			
Pltn Ratio	1.00		1.00	1.00	1.00	1.00			
PF2	1.00		1.00	1.00	1.00	1.00			
Q1	1.4		9.1	0.8	0.0	4.4			
kB	0.8		0.6	0.8	0.2	0.6			
Q2	0.2		4.5	0.1	0.0	0.7			
Q Average	1.6		13.6	0.9	0.0	5.1			
Q Spacing	25.0		25.0	25.0	25.0	25.0			
Q Storage	0		0	0	0	0			
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2			
BOQ	2.0		16.4	1.1	0.0	6.3			
QSRatio									
85th Percentile Output:									
fB%	1.6		1.4	1.7	1.7	1.5			
BOQ	2.6		19.3	1.4	0.0	7.7			
QSRatio									
90th Percentile Output:									
fB%	1.9		1.5	1.9	2.0	1.7			
BOQ	3.0		20.8	1.7	0.0	8.6			
QSRatio									
95th Percentile Output:									
fB%	2.3		1.7	2.4	2.6	2.0			
BOQ	3.7		22.6	2.1	0.0	10.0			
QSRatio									
98th Percentile Output:									
fB%	2.8		1.8	3.0	3.2	2.2			
BOQ	4.4		24.4	2.6	0.0	11.4			
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L	T			TR	
Volume	10		155	230	475	127	113	171		353	32	
Lane Width	10.0		13.0		11.0		12.0	12.0		11.5		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	10.0	15.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	278	1668	0.05	0.17	21.3	C	36.1	D
R	275	1652	0.73	0.17	37.0	D		
Westbound								
LTR	1182	4727	0.81	0.25	25.6	C	25.6	C
Northbound								
L	290	870	0.44	0.33	20.1	C		
T	593	1778	0.32	0.33	16.3	B	17.8	B
Southbound								
TR	1143	3430	0.37	0.33	16.0	B	16.0	B

Intersection Delay = 23.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10		155	230	475	127	113	171		353	32	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		50	66	136	36	32	48		98	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			11.5	
RTOR Vol			0			0						0
Adj Flow	13		201		956		127	192			428	
%InSharedLn												
Prop LTS					0.276		1.000	0.000			0.000	
Prop RTS			1.000		0.153			0.000			0.084	
Peds Bikes	0	0		0	0					0	0	
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		10.0	15.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10		155	230	475	127	113	171		353	32	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	13		201	264	546	146	127	192		392	36	
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
Lane group	L		R			LTR	L		T			TR
Adj flow	13		201			956	127	192				428
Prop LTs						0.276	1.000	0.000				0.000
Prop RTs			1.000		0.153			0.000			0.084	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	1
fW	0.933	1.033	0.967	0.967	1.000	1.000	0.983	0.983
fHV	0.990	0.990	0.980	0.980	0.943	0.943	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.996	0.996
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	0.952	0.952
fRT		0.850	0.977	0.977		1.000	0.987	0.987
fLT	0.950		0.986	0.986	0.485	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4727	4727	870	1778	3430	3430
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	1668	0.01	0.17	278	0.05
Prot							
Perm							
Thru							
Right	R	201	1652	# 0.12	0.17	275	0.73
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	956	4727	# 0.20	0.25	1182	0.81
Right							
Northbound							
Prot							
Perm							
Left	L	127	870	# 0.15	0.33	290	0.44
Prot							
Perm							
Thru	T	192	1778	0.11	0.33	593	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	428	3430	0.12	0.33	1143	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.47
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.63

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.05	0.17	21.0	1.000	278	0.50	0.3	0.0	21.3	C	36.1	D	
R	0.73	0.17	23.7	1.000	275	0.50	13.3	0.0	37.0	D			
Westbound													
LTR	0.81	0.25	21.2	1.000	1182	0.50	4.4	0.0	25.6	C	25.6	C	
Northbound													
L	0.44	0.33	15.6	1.000	290	0.50	4.5	0.0	20.1	C	17.8	B	
T	0.32	0.33	14.9	1.000	593	0.50	1.4	0.0	16.3	B			
Southbound													
TR	0.37	0.33	15.2	1.000	1143	0.50	0.8	0.0	16.0	B	16.0	B	

Intersection delay = 23.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			127	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			428	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.12	
Opposing lane util. factor, fLUo	0.908		0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			3.75	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			0.71	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			19.29	
n=Max(gq-gf)/2,0)			0.35	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.99	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.49	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.485	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.276 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			0.71	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.035	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			428	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	15.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	15.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.153	0.084
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	25.0	21.0	0.00	0.0	0.0	21.3
	0.0						0.0	
R	0.0	0.00	25.0	23.7	0.00	0.0	0.0	37.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	21.2	0.00	0.0	0.0	25.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	15.6	0.00	0.0	0.0	20.1
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.0
	0.0						0.0	

Intersection Delay	23.3	sec/veh	Intersection LOS	C
--------------------	------	---------	------------------	---

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	13	201	350	127	192	224
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	2 0
SL	1668	1652	1735	870	1778	1801
LnCapacity	278	275	433	290	593	600
Flow Ratio	0.0	0.1	0.2	0.1	0.1	0.1
v/c Ratio	0.05	0.73	0.81	0.44	0.32	0.37
Grn Ratio	0.17	0.17	0.25	0.33	0.33	0.33
I Factor		0.830	0.725		0.937	0.817
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2	3.2	5.5	1.7	2.4	2.8
kB	0.3	0.3	0.3	0.3	0.6	0.5
Q2	0.0	0.7	1.3	0.3	0.3	0.3
Q Average	0.2	3.9	6.8	1.9	2.7	3.1
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.2	1.2	1.3	1.3	1.3
BOQ	0.3	4.9	8.3	2.4	3.3	3.9
QSRatio						
85th Percentile Output:						
fB%	1.7	1.5	1.5	1.6	1.6	1.6
BOQ	0.3	6.0	10.0	3.1	4.2	4.9
QSRatio						
90th Percentile Output:						
fB%	2.0	1.7	1.6	1.8	1.8	1.8
BOQ	0.4	6.8	11.1	3.5	4.8	5.5
QSRatio						
95th Percentile Output:						
fB%	2.6	2.1	1.9	2.3	2.2	2.1
BOQ	0.5	8.0	12.6	4.4	5.8	6.7
QSRatio						
98th Percentile Output:						
fB%	3.1	2.4	2.1	2.7	2.6	2.5
BOQ	0.6	9.3	14.2	5.2	6.9	7.8
QSRatio						

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 10/7/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 Miti-Action Conditions

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	204		188	209		234	191		191			
Lane Width	16.0			10.0	10.0			11.0				
RTOR Vol			44						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	923	1845	0.42	0.50	15.6	B	15.6	B
----	-----	------	------	------	------	---	------	---

Westbound

L	332	663	0.69	0.50	28.4	C		
T	765	1529	0.34	0.50	14.7	B	21.2	C

Northbound

LR	557	1433	0.78	0.39	33.7	C	33.7	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 23.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		204	188	209	234		191		191			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		57	52	57	64		54		54			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		10.0	10.0			11.0				
RTOR Vol			44						0			
Adj Flow		387		230	257			434				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.500				
Prop RTs		0.413			0.000			0.500				
Peds Bikes		0						0		0		
Buses		5		0	0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		204	188	209	234		191		191			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		227	160	230	257		217		217			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		387		230	257		434					
Prop LTs		0.000		1.000	0.000		0.500					
Prop RTs		0.413		0.000			0.500					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.933	0.933		0.967		
fHV	0.926		0.862	0.862		0.980		
fG	1.000		1.000	1.000		1.000		
fP	1.000		1.000	1.000		0.875		
fBB	0.980		1.000	1.000		1.000		
fA	1.000		1.000	1.000		1.000		
fLU	1.000		1.000	1.000		1.000		
fRT	0.944			1.000		0.933		
fLT	1.000		0.434	1.000		0.976		
Sec.								
fLpb	1.000		1.000	1.000		1.000		
fRpb	1.000			1.000		1.000		
S	1845		663	1529		1433		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	387	1845	0.21	0.50	923	0.42
Right							
Westbound							
Prot							
Perm							
Left	L	230	663	# 0.35	0.50	332	0.69
Prot							
Perm							
Thru	T	257	1529	0.17	0.50	765	0.34
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	434	1433	# 0.30	0.39	557	0.78
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.42	0.50	14.2	1.000	923	0.50	1.3	0.0	15.6	B	15.6	B
Westbound												
L	0.69	0.50	17.2	1.000	332	0.50	11.2	0.0	28.4	C		
T	0.34	0.50	13.5	1.000	765	0.50	1.2	0.0	14.7	B	21.2	C
Northbound												
LR	0.78	0.39	24.1	1.000	557	0.50	9.6	0.0	33.7	C	33.7	C
Southbound												

Intersection delay = 23.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		230		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		387		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		5.75		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.68		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		8.36		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		36.64		
n=Max(gq-gf)/2,0)		4.18		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.88		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.09		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.43		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.434		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.500
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound		
LaneGroup		TR	L	T		LR			
Init Queue		0.0	0.0	0.0		0.0			
Flow Rate		387	230	257		434			
So		1900	1900	1900		1900			
No.Lanes	0	1	0	1	0	0	0	0	0
SL		1845	663	1529		1433			
LnCapacity		923	332	765		557			
Flow Ratio		0.2	0.3	0.2		0.3			
v/c Ratio		0.42	0.69	0.34		0.78			
Grn Ratio		0.50	0.50	0.50		0.39			
I Factor		0.961		0.989		0.922			
AT or PVG		3	3	3		3			
Pltn Ratio		1.00	1.00	1.00		1.00			
PF2		1.00	1.00	1.00		1.00			
Q1		6.1	4.4	3.9		9.5			
kB		1.0	0.5	0.9		0.7			
Q2		0.7	1.1	0.5		2.2			
Q Average		6.9	5.5	4.3		11.7			
Q Spacing		25.0	25.0	25.0		25.0			
Q Storage		0	0	0		0			
Q S Ratio									
70th Percentile Output:									
fB%		1.2	1.2	1.2		1.2			
BOQ		8.4	6.8	5.4		14.1			
QSRatio									
85th Percentile Output:									
fB%		1.5	1.5	1.5		1.4			
BOQ		10.1	8.2	6.6		16.7			
QSRatio									
90th Percentile Output:									
fB%		1.6	1.7	1.7		1.5			
BOQ		11.2	9.1	7.4		18.1			
QSRatio									
95th Percentile Output:									
fB%		1.9	1.9	2.0		1.7			
BOQ		12.7	10.6	8.8		19.8			
QSRatio									
98th Percentile Output:									
fB%		2.1	2.2	2.3		1.8			
BOQ		14.3	12.1	10.1		21.5			
QSRatio									

ERROR MESSAGES

No errors to report.

Weekday

PM

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			344	63		19	337	
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81	
Hourly Flow Rate, HFR			395	72		23	416	
Percent Heavy Vehicles			--	--		7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		111		31				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		163		45				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage					/			
Lanes		1		1				
Configuration		L		R				

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8		10	11
Lane Config		LT		L		R		12
v (vph)		23		163		45		
C(m) (vph)		1069		299		614		
v/c		0.02		0.55		0.07		
95% queue length		0.07		3.05		0.24		
Control Delay		8.4		30.6		11.3		
LOS		A		D		B		
Approach Delay					26.4			
Approach LOS					D			

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		344	63	19	337	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		99	18	6	104	
Hourly Flow Rate, HFR		395	72	23	416	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R

Volume	111		31			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	41		11			
Hourly Flow Rate, HFR	163		45			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		416
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		467	893		431			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	431	
Potential Capacity	614	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	614	
Probability of Queue free St.	0.93	1.00

Step 2: LT from Major St.	4	1
Conflicting Flows	467	
Potential Capacity	1069	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1069	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.97	

Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
Conflicting Flows	893	
Potential Capacity	306	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.91
Movement Capacity	299	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 893
Potential Capacity 306
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.97
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.91
Movement Capacity 299

Results for Two-stage process:

a
y
C t 299

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	163		45			
Movement Capacity (vph)	299		614			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	299		614			
Volume	163		45			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		23	163		45			
C(m) (vph)		1069	299		614			
v/c		0.02	0.55		0.07			
95% queue length		0.07	3.05		0.24			
Control Delay		8.4	30.6		11.3			
LOS		A	D		B			
Approach Delay				26.4				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		416
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.97
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	1	11	2	377	20	306	4	183	341	295	261	1
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	725	1740	0.02	0.42	10.4	B	10.4	B
Westbound								
LT	528	1268	0.92	0.42	38.6	D	31.4	C
R	523	1256	0.71	0.42	22.1	C		
Northbound								
LT	741	1778	0.27	0.42	12.3	B	15.2	B
R	641	1538	0.57	0.42	16.8	B		
Southbound								
L	436	1047	0.79	0.42	28.6	C		
TR	709	1702	0.43	0.42	14.3	B	21.9	C

Intersection Delay = 23.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	377	20	306	4	183	341	295	261	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	115	6	93	1	49	92	86	76	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900	1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			484	373		201	367	343	304	
%InSharedLn												
Prop LTs		0.063			0.950			0.020		1.000	0.000	
Prop RTs		0.125			0.000	1.000		0.000	1.000		0.003	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3	0	0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	377	20	306	4	183	341	295	261	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	460	24	373	4	197	367	343	303	1
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	16			484 373			201 367			343 304		
Prop LTs	0.063			0.950			0.020			1.000 0.000		
Prop RTs	0.125			0.000 1.000			0.000 1.000			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.971			0.952 0.952			0.952 0.952			0.935 0.935		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988 1.000			1.000 0.992		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.983			1.000 0.850			1.000 0.850			1.000		
fLT	0.982			0.725			0.994			0.632 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1740			1268 1256			1778 1538			1047 1702		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1740	0.01	0.42	725	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1268	# 0.38	0.42	528	0.92
Right	R	373	1256	0.30	0.42	523	0.71
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	201	1778	0.11	0.42	741	0.27
Right	R	367	1538	0.24	0.42	641	0.57
Southbound							
Prot							
Perm							
Left	L	343	1047	# 0.33	0.42	436	0.79
Prot							
Perm							
Thru	TR	304	1702	0.18	0.42	709	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	725	0.50	0.1	0.0	10.4	B	10.4	B	
Westbound													
LT	0.92	0.42	16.5	1.000	528	0.50	22.0	0.0	38.6	D	31.4	C	
R	0.71	0.42	14.5	1.000	523	0.50	7.5	0.0	22.1	C			
Northbound													
LT	0.27	0.42	11.5	1.000	741	0.50	0.8	0.0	12.3	B	15.2	B	
R	0.57	0.42	13.4	1.000	641	0.50	3.4	0.0	16.8	B			
Southbound													
L	0.79	0.42	15.2	1.000	436	0.50	13.4	0.0	28.6	C			
TR	0.43	0.42	12.4	1.000	709	0.50	1.9	0.0	14.3	B	21.9	C	

Intersection delay = 23.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				343
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				201
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				5.72
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.35
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.58
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.16
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.63
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.632

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	460	4	
Proportion of LT in LT lane group, PLT	0.063	0.950	0.020	0.000
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.00	
Adjusted opposing flow rate, Vo (veh/h)	484	16	304	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.67	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.07	0.27	5.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	17.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	8.69	0.00	2.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	7.97	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.05	0.94	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.02	
EL1 (refer to Exhibit C16-3)	2.26	1.40	1.89	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.725	0.994	

For special case of single-lane approach opposed by multilane approach,
see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.69		2.11	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.348		0.084	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	484		304	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.020	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.5	0.00	0.0	0.0	38.6
R	0.0	0.00	17.5	14.5	0.00	0.0	0.0	22.1
Northbound								
	0.0						0.0	
LT	0.0	0.00	17.5	11.5	0.00	0.0	0.0	12.3
R	0.0	0.00	17.5	13.4	0.00	0.0	0.0	16.8
Southbound								
L	0.0	0.00	17.5	15.2	0.00	0.0	0.0	28.6
TR	0.0	0.00	17.5	12.4	0.00	0.0	0.0	14.3
	0.0						0.0	
Intersection Delay			23.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16		484	373	201	367	343	304
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	0	
SL	1740		1268	1256	1778	1538	1047	1702
LnCapacity	725		528	523	741	641	436	709
Flow Ratio	0.0		0.4	0.3	0.1	0.2	0.3	0.2
v/c Ratio	0.02		0.92	0.71	0.27	0.57	0.79	0.43
Grn Ratio	0.42		0.42	0.42	0.42	0.42	0.42	0.42
I Factor	1.000		0.933		0.919		1.000	
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2		7.6	5.2	2.2	4.7	5.0	3.6
kB	0.7		0.5	0.5	0.6	0.6	0.5	0.7
Q2	0.0		3.5	1.2	0.2	0.8	1.6	0.5
Q Average	0.2		11.1	6.4	2.4	5.4	6.5	4.1
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.2
BOQ	0.2		13.4	7.8	3.1	6.7	8.0	5.1
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.5	1.6	1.5	1.5	1.5
BOQ	0.3		15.9	9.4	3.9	8.2	9.7	6.3
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.8	1.7	1.6	1.7
BOQ	0.3		17.2	10.4	4.4	9.1	10.7	7.1
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	1.9	2.2	1.9	1.9	2.0
BOQ	0.4		18.9	11.9	5.4	10.5	12.2	8.4
QSRatio								
98th Percentile Output:								
fB%	3.1		1.9	2.1	2.6	2.2	2.1	2.4
BOQ	0.5		20.6	13.5	6.4	12.0	13.7	9.7
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 10/7/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				134		181	592	105		150	749	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 397 1487 0.94 0.27 52.6 D 52.6 D

Northbound

TR 1098 1937 0.68 0.57 12.0 B 12.0 B

Southbound

L 266 469 0.65 0.57 10.4 B
 T 941 1660 0.93 0.57 14.4 B 13.7 B

Intersection Delay = 19.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				134		181	592	105		150	749	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				40		54	159	28		44	218	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					375			750		174	871	
%InSharedLn												
Prop LTS					0.427			0.000		1.000	0.000	
Prop RTS					0.573			0.151			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.901			0.798				0.114	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				134		181	592	105		150	749	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				160		215	637	113		174	871	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					375			750		174	871	
Prop LTs					0.427			0.000		1.000	0.000	
Prop RTs					0.573			0.151			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.990			0.962			0.943	0.943	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.984			1.000	0.992	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.923			0.980				1.000	
fLT				0.979			1.000			0.281	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1487			1937			469	1660	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	375	1487	# 0.25	0.27	397	0.94
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	750	1937	0.39	0.57	1098	0.68
Right							
Southbound							
Prot							
Perm							
Left	L	174	469	0.37	0.57	266	0.65
Prot							
Perm							
Thru	T	871	1660	# 0.52	0.57	941	0.93
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.93

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.94	0.27	21.6	1.000	397	0.50	31.0	0.0	52.6	D	52.6	D
Northbound												
TR	0.68	0.57	9.2	1.000	1098	0.50	2.8	0.0	12.0	B	12.0	B
Southbound												
L	0.65	0.57	9.0	1.000	266	0.50	1.4	0.0	10.4	B		
T	0.93	0.57	11.8	1.000	941	0.50	2.5	0.0	14.4	B	13.7	B

Intersection delay = 19.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				174
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				750
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				2.90
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				12.50
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				8.95
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.05
n=Max(gq-gf)/2,0)				4.47
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.28
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.281

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.427 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.95
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.263
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				750
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.573	0.151
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.6	0.00	0.0	0.0	52.6
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.2	0.00	0.0	0.0	12.0
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	9.0	0.00	0.0	0.0	10.4
T	0.0	0.00	13.0	11.8	0.00	0.0	0.0	14.4
	0.0						0.0	
Intersection Delay			19.8	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					375		750	174	871
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1487		1937	469	1660
LnCapacity					397		1098	266	941
Flow Ratio					0.3		0.4	0.4	0.5
v/c Ratio					0.94		0.68	0.65	0.93
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.901		0.798		0.114
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					6.1		8.8	2.0	13.2
kB					0.4		0.7	0.0	0.1
Q2					3.2		1.5	0.1	1.0
Q Average					9.3		10.4	2.1	14.3
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					11.3		12.6	2.6	17.2
QSRatio									
85th Percentile Output:									
fB%					1.4		1.4	1.6	1.4
BOQ					13.5		14.9	3.3	20.2
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.8	1.5
BOQ					14.7		16.2	3.8	21.8
QSRatio									
95th Percentile Output:									
fB%					1.8		1.7	2.3	1.7
BOQ					16.4		17.9	4.7	23.7
QSRatio									
98th Percentile Output:									
fB%					1.9		1.9	2.7	1.8
BOQ					18.0		19.6	5.6	25.5
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 FULL Mitigated Action
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	161	344	210	247	532	87	159	285	150	223	77	106
Lane Width	11.0	12.0	11.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	37.0				18.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	207	503	0.88	0.41	54.2	D		
T	773	1881	0.51	0.41	21.4	C	28.6	C
R	636	1546	0.30	0.41	18.6	B		
Westbound								
L	294	696	0.93	0.42	61.1	E		
TR	1401	3317	0.53	0.42	20.7	C	31.6	C
Northbound								
LT	702	3508	0.68	0.20	38.6	D	38.2	D
R	293	1463	0.46	0.20	36.8	D		
Southbound								
L	384	1728	0.76	0.22	45.8	D		
TR	360	1620	0.58	0.22	37.7	D	42.4	D

Intersection Delay = 34.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 FULL Mitigated Action
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161	344	210	247	532	87	159	285	150	223	77	106
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	46	98	60	69	162	27	43	77	40	73	25	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1950	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	11.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	183	391	188	274	742			477	134	293	208	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.358			0.000	
Prop RTS		0.000	1.000		0.125			0.000	1.000		0.514	
Peds Bikes	0			0	0	0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.701			0.949			1.000			0.970	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		37.0						18.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161	344	210	247	532	87	159	285	150	223	77	106
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	183	391	188	274	649	93	171	306	134	293	101	107
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	183	391	188	274	742			477	134	293	208	
Prop LTs	1.000	0.000		1.000	0.000			0.358			0.000	
Prop RTs		0.000	1.000		0.125			0.000	1.000		0.514	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1950	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.967	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.935	0.935		0.971	0.971		0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.981		1.000	0.850			0.923	
fLT	0.277	1.000		0.409*	1.000		0.982			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	503	1881	1546	696	3317		3508	1463		1728	1620	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	183	503	0.36	0.41	207	0.88
Prot							
Perm							
Thru	T	391	1881	0.21	0.41	773	0.51
Right	R	188	1546	0.12	0.41	636	0.30
Westbound							
Prot							
Perm							
Left	L	274	696	# 0.39	0.42	294	0.93
Prot							
Perm							
Thru	TR	742	3317	0.22	0.42	1401	0.53
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	477	3508	# 0.14	0.20	702	0.68
Right	R	134	1463	0.09	0.20	293	0.46
Southbound							
Prot							
Perm							
Left	L	293	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	208	1620	0.13	0.22	360	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.88	0.41	24.5	1.000	207	0.50	29.6	0.0	54.2	D		
T	0.51	0.41	19.7	1.000	773	0.50	1.7	0.0	21.4	C	28.6	C
R	0.30	0.41	17.8	1.000	636	0.50	0.8	0.0	18.6	B		
Westbound												
L	0.93	0.42	24.8	1.000	294	0.50	36.4	0.0	61.1	E		
TR	0.53	0.42	19.3	1.000	1401	0.50	1.4	0.0	20.7	C	31.6	C
Northbound												
LT	0.68	0.20	33.3	1.000	702	0.50	5.2	0.0	38.6	D	38.2	D
R	0.46	0.20	31.7	1.000	293	0.50	5.1	0.0	36.8	D		
Southbound												
L	0.76	0.22	32.8	1.000	384	0.50	13.0	0.0	45.8	D		
TR	0.58	0.22	31.2	1.000	360	0.50	6.4	0.0	37.7	D	42.4	D

Intersection delay = 34.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	37.0	37.0		
Effective permitted green time for LT lane group, g(s)	37.0	38.0		
Opposing effective green time, go (s)	38.0	37.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	183	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	742	391		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.58	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.74	9.77		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.58	0.59		
gq, (see Exhibit C16-4,5,6,7,8)	9.37	10.71		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	27.63	27.29		
n=Max(gq-gf)/2,0)	4.68	5.35		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.70	1.88		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.11	0.11		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.28	0.38		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.277	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.358 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC ** b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho ** n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N **$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	37.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	9.37			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.253			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	742			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	37.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	38.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.5	24.5	0.00	0.0	0.0	54.2
T	0.0	0.00	26.5	19.7	0.00	0.0	0.0	21.4
R	0.0	0.00	26.5	17.8	0.00	0.0	0.0	18.6
Westbound								
L	0.0	0.00	26.0	24.8	0.00	0.0	0.0	61.1
TR	0.0	0.00	26.0	19.3	0.00	0.0	0.0	20.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	36.0	33.3	0.00	0.0	0.0	38.6
R	0.0	0.00	36.0	31.7	0.00	0.0	0.0	36.8
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.8
TR	0.0	0.00	35.0	31.2	0.00	0.0	0.0	37.7
	0.0						0.0	

Intersection Delay	34.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	TR		LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	183	391	188	274	389		250	134	293	208
So	1900	1900	1900	1950	1900		1900	1900	1900	1900
No.Lanes	1	1	1	1	2	0	2	1	1	0
SL	503	1881	1546	696	1742		1842	1463	1728	1620
LnCapacity	207	773	636	294	735		368	293	384	360
Flow Ratio	0.4	0.2	0.1	0.4	0.2		0.1	0.1	0.2	0.1
v/c Ratio	0.88	0.51	0.30	0.93	0.53		0.68	0.46	0.76	0.58
Grn Ratio	0.41	0.41	0.41	0.42	0.42		0.20	0.20	0.22	0.22
I Factor		0.701			0.949		1.000			0.970
AT or PVG	3	3	3	3	3		3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Q1	4.2	7.3	3.2	6.5	7.2		5.8	2.9	6.9	4.6
kB	0.3	0.7	0.6	0.5	0.9		0.6	0.5	0.6	0.5
Q2	1.4	0.7	0.2	2.9	1.0		1.1	0.4	1.6	0.7
Q Average	5.6	7.9	3.4	9.4	8.2		6.9	3.3	8.5	5.4
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2	1.3	1.2	1.2		1.2	1.3	1.2	1.2
BOQ	6.9	9.7	4.2	11.5	10.0		8.5	4.2	10.3	6.6
QSRatio										
85th Percentile Output:										
fB%	1.5	1.5	1.6	1.4	1.5		1.5	1.6	1.5	1.5
BOQ	8.4	11.6	5.3	13.6	12.0		10.2	5.2	12.3	8.0
QSRatio										
90th Percentile Output:										
fB%	1.7	1.6	1.8	1.6	1.6		1.6	1.8	1.6	1.7
BOQ	9.3	12.7	6.0	14.9	13.1		11.2	5.9	13.5	8.9
QSRatio										
95th Percentile Output:										
fB%	1.9	1.8	2.1	1.8	1.8		1.9	2.1	1.8	1.9
BOQ	10.8	14.3	7.2	16.5	14.7		12.8	7.1	15.1	10.4
QSRatio										
98th Percentile Output:										
fB%	2.2	2.0	2.5	1.9	2.0		2.1	2.5	2.0	2.2
BOQ	12.3	15.9	8.4	18.2	16.3		14.3	8.3	16.7	11.9
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: ML
 Agency: AECOM
 Date: 08/19/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	53	137	504	239	463	10	286	145	124	21	532	123
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	26.0	17.0			24.0	7.0		
Yellow	3.0	3.0			3.0	3.0		
All Red	0.0	2.0			0.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	178	616	0.34	0.29	29.7	C		
TR	904	3129	0.81	0.29	36.5	D	36.0	D
Westbound								
DefL	524	1770	0.56	0.51	29.5	C		
TR	949	1857	0.61	0.51	18.3	B	22.0	C
Northbound								
DefL	332	1847	0.93	0.38	69.5	E		
TR	684	1810	0.42	0.38	22.6	C	46.8	D
Southbound								
L	240	900	0.09	0.27	25.6	C		
TR	842	3159	0.83	0.27	40.2	D	39.8	D

Intersection Delay = 35.0+ (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/19/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	53	137	504	239	463	10	286	145	124	21	532	123
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	15	39	143	73	141	3	77	39	33	6	141	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	60	729		291	577		308	289		22	697	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.786			0.021			0.460			0.188	
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0			0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P	P			SB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		26.0	17.0					24.0	7.0
Yellow		3.0	3.0					3.0	3.0
All Red		0.0	2.0					0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	53	137	504	239	463	10	286	145	124	21	532	123
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	60	156	573	291	565	12	308	156	133	22	566	131
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	60	729		291	577		308	289		22	697	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs	0.786			0.021			0.460			0.188		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.933	1.000		1.000	1.000		1.033	1.033		0.900	0.917	
fHV	0.980	0.980		0.980	0.980		0.990	0.990		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.882			0.997			0.931			0.972	
fLT	0.354	1.000		0.950	1.000		0.950	1.000		0.537	1.000	
Sec.				0.183			0.182					
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	616	3129		1770	1857		1847	1810		900	3159	
Sec.				341			353					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	60	616	0.10	0.29	178	0.34
Prot							
Perm							
Thru	TR	729	3129	0.23	0.29	904	0.81
Right							
Westbound							
Prot		200	1770	0.11	0.244	433	0.46
Perm		91	341	0.27	0.267	91	1.00
Left	DefL	291			0.51	524	0.56
Prot							
Perm				#			
Thru	TR	577	1857	# 0.31	0.51	949	0.61
Right							
Northbound							
Prot		222	1847	0.12	0.133	246	0.90
Perm		86	353	0.24	0.244	86	1.00
Left	DefL	308			0.38	332	0.93
Prot							
Perm				#			
Thru	TR	289	1810	# 0.16	0.38	684	0.42
Right							
Southbound							
Prot							
Perm							
Left	L	22	900	0.02	0.27	240	0.09
Prot							
Perm							
Thru	TR	697	3159	0.22	0.27	842	0.83
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.98

Total lost time per cycle, L = 20.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.26

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.34	0.29	25.2	1.000	178	0.50	4.5	0.0	29.7	C		
TR	0.81	0.29	29.7	1.000	904	0.50	6.8	0.0	36.5	D	36.0	D
Westbound												
DefL	0.56	0.51	25.6	1.000	524	0.50	3.9	0.0	29.5	C		
TR	0.61	0.51	15.6	1.000	949	0.50	2.7	0.0	18.3	B	22.0	C
Northbound												
DefL	0.93	0.38	35.5	1.000	332	0.50	34.0	0.0	69.5	E		
TR	0.42	0.38	20.7	1.000	684	0.50	1.9	0.0	22.6	C	46.8	D
Southbound												
L	0.09	0.27	24.8	1.000	240	0.50	0.8	0.0	25.6	C		
TR	0.83	0.27	31.1	1.000	842	0.50	9.2	0.0	40.2	D	39.8	D

Intersection delay = 35.0+ (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

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for exclusive lefts

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Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)	26.0	46.0	34.0	24.0
Effective permitted green time for LT lane group, g(s)	26.0	24.0	22.0	24.0
Opposing effective green time, go (s)	46.0	26.0	24.0	34.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	60	291	308	22
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	577	729	697	289
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.50	7.28	7.70	0.55
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.21	9.57	9.15	3.61
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.49	0.71	0.73	0.62
gq, (see Exhibit C16-4,5,6,7,8)	5.40	12.29	11.85	1.89
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.60	11.71	10.15	22.11
n=Max(gq-gf)/2,0)	2.70	6.15	5.92	0.94
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.24	2.67	2.58	1.72
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15	0.17	0.18	0.17
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.35	0.18	0.18	0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.354	0.183	0.182	0.537

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

**** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.**

For special case of multilane approach, opposed by single-lane approach
or when $qf > qg$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	26.0	26.0		24.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	5.40	12.29		1.89
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.208	0.473		0.079
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	577	729		289
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	1.000		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	26.0	46.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	26.0	46.0	34.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.786	0.021	0.460
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	291	308		
v/c ratio from Capacity Worksheet, X	0.56	0.93		
Protected phase effective green interval, g (s)	22.0	12.0		
Opposing queue effective green interval, gq	12.29	11.85		
Unopposed green interval, gu	11.71	10.15		
Red time r=(C-g-gq-gu)	44.0	56.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08	0.09		
Protected ph. departure rate, Sp=s/3600	0.492	0.513		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.19	0.21		
XPerm	2.42	3.09		
XProt				
Case	5	5		
Queue at beginning of green arrow, Qa	3.22	4.52		
Queue at beginning of unsaturated green, Qu	4.55	5.80		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	25.6	35.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	32.0	25.2	0.00	0.0	0.0	29.7
TR	0.0	0.00	32.0	29.7	0.00	0.0	0.0	36.5
	0.0						0.0	
Westbound								
DefL	0.0	0.00		25.6	0.00	0.0	0.0	29.5
TR	0.0	0.00	22.0	15.6	0.00	0.0	0.0	18.3
	0.0						0.0	
Northbound								
DefL	0.0	0.00		35.5	0.00	0.0	0.0	69.5
TR	0.0	0.00	28.0	20.7	0.00	0.0	0.0	22.6
	0.0						0.0	
Southbound								
L	0.0	0.00	33.0	24.8	0.00	0.0	0.0	25.6
TR	0.0	0.00	33.0	31.1	0.00	0.0	0.0	40.2
	0.0						0.0	

Intersection Delay 35.0+ sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	60	382		291	577		308	289		22	366	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	616	1643		1024	1857		880	1810		900	1659	
LnCapacity	178	474		524	949		332	684		240	442	
Flow Ratio	0.1	0.2		0.3	0.3		0.3	0.2		0.0	0.2	
v/c Ratio	0.34	0.81		0.56	0.61		0.93	0.42		0.09	0.83	
Grn Ratio	0.29	0.29		0.51	0.51		0.38	0.38		0.27	0.27	
I Factor		0.884			0.927			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	1.2	8.9		4.1	10.2		5.5	5.3		0.4	8.6	
kB	0.3	0.6		0.7	1.0		0.5	0.9		0.4	0.6	
Q2	0.2	2.1		0.8	1.5		3.3	0.6		0.0	2.5	
Q Average	1.3	11.0		4.9	11.8		8.7	6.0		0.5	11.1	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	1.7	13.3		6.1	14.2		10.6	7.4		0.6	13.4	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.5	1.4		1.5	1.5		1.7	1.4	
BOQ	2.2	15.7		7.5	16.8		12.7	8.9		0.8	15.9	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.6		1.7	1.5		1.6	1.7		2.0	1.6	
BOQ	2.5	17.0		8.3	18.2		13.8	9.9		0.9	17.2	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.7		2.0	1.7		1.8	1.9		2.5	1.7	
BOQ	3.2	18.8		9.7	19.9		15.5	11.4		1.1	18.9	
QSRatio												
98th Percentile Output:												
fB%	2.8	1.9		2.3	1.8		2.0	2.2		3.1	1.9	
BOQ	3.8	20.5		11.1	21.7		17.1	12.9		1.4	20.6	
QSRatio												

ERROR MESSAGES

WARNING: Phase 6 < minimum green time for peds.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/29/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Period	Year : 2020 FULL Mitigation
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L		TR		LT	R			LTR	L		LT R
Volume	747	395	4	3	404	868	2	3	2	151	0	288
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

		Signal Operations								
Phase	Combination	1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds			
WB	Left		P			SB	Left	P		
	Thru		P				Thru	P		
	Right	P	P				Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right	P		
Green		38.0	23.0					14.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Intersection Performance Summary								
Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	816	1728	1.02	0.73	51.5	D		
TR	1206	1644	0.37	0.73	5.0	A	35.3	D
Westbound								
LT	479	1876	0.86	0.26	44.3	D	14.4	B
R	1599	1599	0.57	1.00	1.0	A		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.79	0.16	62.5	E		
LT	283	1818	0.00	0.16	32.1	C	25.6	C
R	945	1492	0.38	0.63	9.1	A		
Intersection Delay = 24.9 (sec/veh) Intersection LOS = C								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	747	395	4	3	404	868	2	3	2	151	0	288
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.99	0.95	0.44	0.44	0.44	0.94	0.80	0.80
PK 15 Vol	208	110	1	1	102	228	1	2	1	40	0	90
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	830	443			411	914		17		161	0	360
%InSharedLn										0		
Prop LTS	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTS		0.009			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.687		0.650			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6		24.6			20.9			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		38.0	23.0				14.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	747	395	4		3	404	868		2	3	2		151	0	288
PHF	0.90	0.90	0.90		0.95	0.99	0.95		0.44	0.44	0.44		0.94	0.80	0.80
Adj flow	830	439	4		3	408	914		5	7	5		161	0	360
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	830	443				411	914			17			161	0	360
Prop LTs	1.000	0.000				0.007				0.294			1.000	0.000	
Prop RTs		0.009				0.000	1.000			0.294				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.990	0.990			0.990				0.990	0.990	0.990
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.999			1.000	0.850			0.960					1.000	0.850
fLT	0.950	1.000			0.997				0.465				0.746	1.000	
Sec.	0.152														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1644			1876	1599			952				1310	1818	1492
Sec.	277														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		730	1728	# 0.42	0.422	730	1.00
Perm		100	277	# 0.36	0.311	86	1.16
Left	L	830			0.73	816	1.02
Prot							
Perm							
Thru	TR	443	1644	0.27	0.73	1206	0.37
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	411	1876	0.22	0.26	479	0.86
Right	R	914	1599	0.57	1.00	1599	0.57
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	161	1310	# 0.12	0.16	204	0.79
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	360	1492	0.24	0.63	945	0.38

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.91
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.02

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.02	0.73	21.0	1.000	816	0.50	30.5	0.0	51.5	D			
TR	0.37	0.73	4.4	1.000	1206	0.50	0.6	0.0	5.0	A	35.3	D	
Westbound													
LT	0.86	0.26	31.9	1.000	479	0.50	12.4	0.0	44.3	D	14.4	B	
R	0.57	1.00	0.0	0.950	1599	0.50	1.0	0.0	1.0	A			
Northbound													
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C	
Southbound													
L	0.79	0.16	36.6	1.000	204	0.50	25.9	0.0	62.5	E			
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	25.6	C	

R 0.38 0.63 8.0 1.000 945 0.50 1.2 0.0 9.1 A

Intersection delay = 24.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	28.0			14.0
Opposing effective green time, go (s)	23.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	830			161
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	411			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	20.75			4.03
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.27			0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.74			0.84
gq, (see Exhibit C16-4,5,6,7,8)	19.83			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.17			14.00
n=Max(gq-gf)/2,0)	9.91			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.92			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	9.60			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			0.29
gdifff=max(gq-gf,0)	19.83			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.152			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		23.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		23.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.007	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	443	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.07	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	15.0	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.96	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.17	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.18	0.14
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		23.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		443		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.007		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	66.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	66.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.009
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	830			
v/c ratio from Capacity Worksheet, X	1.02			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	19.83			
Unopposed green interval, gu	8.17			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.26			
XPerm	2.95			
XProt	0.77			
Case	3			
Queue at beginning of green arrow, Qa	9.63			
Queue at beginning of unsaturated green, Qu	4.49			
Residual queue, Qr	4.19			
Uniform Delay, d1	21.0			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.0	0.00	3.5	0.0	51.5
TR	0.0	0.00	12.0	4.4	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	33.5	31.9	0.00	0.0	0.0	44.3
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	1.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	36.6	0.00	0.0	0.0	62.5
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	16.5	8.0	0.00	0.0	0.0	9.1

Intersection Delay	24.9	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	830	443		411	914	17		161	0	360
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1112	1644		1876	1599	952		1310	1818	1492
LnCapacity	816	1206		479	1599	148		204	283	945
Flow Ratio	0.7	0.3		0.2	0.6	0.0		0.1	0.0	0.2
v/c Ratio	1.02	0.37		0.86	0.57	0.11		0.79	0.00	0.38
Grn Ratio	0.73	0.73		0.26	1.00	0.16		0.16	0.16	0.63
I Factor		0.687		0.650		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	9.6	4.0		9.8		0.4		3.9	0.0	4.3
kB	0.7	0.9		0.4	1.0	0.3		0.4	0.5	1.1
Q2	9.3	0.5		2.1	1.4	0.0		1.2	0.0	0.7
Q Average	18.9	4.6		11.9		0.4		5.0	0.0	5.0
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2		1.3		1.2	1.3	1.2
BOQ	22.7	5.7		14.4		0.5		6.2	0.0	6.2
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4		1.7		1.5	1.7	1.5
BOQ	26.6	6.9		17.0		0.7		7.6	0.0	7.6
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5		2.0		1.7	2.0	1.7
BOQ	28.6	7.8		18.5		0.8		8.5	0.0	8.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7		2.5		2.0	2.6	2.0
BOQ	30.7	9.1		20.2		1.0		9.9	0.0	9.9
QSRatio										
98th Percentile Output:										
fB%	1.7	2.3		1.8		3.1		2.2	3.2	2.2
BOQ	32.8	10.5		21.9		1.2		11.3	0.0	11.3
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 10/7/13	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2020 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		31.0	11.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	845	2025	0.68	0.50	22.2	C		
TR	1066	2132	0.04	0.50	11.5	B	21.5	C

LTR	1075	3122	0.07	0.34	19.9	B	19.9	B
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LTR	1220	3136	0.01	0.39	16.9	B	16.9	B
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LT	548	1410	0.12	0.39	18.1	B	82.0	F
R	897	1583	1.12	0.57	86.3	F		

Intersection Delay = 58.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	514	36	0	1	36	43	3	3	2	62	1	1236	
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2	
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94	
PK 15 Vol	143	10	0	1	9	11	2	2	1	16	1	329	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900			1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R	
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0	
RTOR Vol			0			10			0			294	
Adj Flow	571	40			74			16			67	1002	
%InSharedLn													
Prop LTs	1.000	0.000			0.014			0.375			0.985		
Prop RTs		0.000			0.473			0.250			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0			0			0	0	
%InProtPhase	0.0		0.0									0.0	
Duration	0.25			Area Type: All other areas									

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		31.0	11.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	514	36	0	1	36	43	3	3	2	62	1	1236
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	571	40	0	1	38	35	6	6	4	66	1	1002
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	571	40			74			16			67	1002
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.929			0.962		1.000	0.850
fLT	0.950	1.000			0.954			0.910		0.757	
Sec.	0.706										
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	2025	2132			3122			3136		1410	1583
Sec.	1506										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	86	2025	0.04	0.178	360	0.24
Perm		485	1506	# 0.32	0.322	485	1.00
Left		571			0.50	845	0.68
Prot	TR	40	2132	0.02	0.50	1066	0.04
Perm							
Thru							
Right	LTR	74	3122	0.02	0.34	1075	0.07
Prot							
Perm							
Left	LTR	16	3136	0.01	0.39	1220	0.01
Prot							
Perm							
Thru	LT	67	1410	0.05	0.39	548	0.12
Right							
Prot	R	1002	1583	# 0.63	0.57	897	1.12
Perm							
Left							
Prot	LT	67	1410	0.05	0.39	548	0.12
Perm							
Thru							
Right	R	1002	1583	# 0.63	0.57	897	1.12

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.96
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.68	0.50	18.1	1.000	845	0.50	4.1	0.0	22.2	C			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	21.5	C	
Westbound													
LTR	0.07	0.34	19.8	1.000	1075	0.50	0.1	0.0	19.9	B	19.9	B	
Northbound													
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.12	0.39	17.6	1.000	548	0.50	0.4	0.0	18.1	B	82.0	F	

R 1.12 0.57 19.5 1.000 897 0.50 66.8 0.0 86.3 F

Intersection delay = 58.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	29.0			
Opposing effective green time, go (s)	31.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	571			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	74			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	14.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	29.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.42			
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.706			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		31.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		31.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	1	6	66
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375
Proportion of LT in opposing flow, PLTo	0.00	0.99	0.38
Adjusted opposing flow rate, Vo (veh/h)	40	67	16
Lost time for LT lane group, tL	3.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.65
Opposing lane util. factor, fLUo	0.952	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	1.67	0.21
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.1	22.9	4.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.88	12.09	30.10
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.01	0.63
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.99
EL1 (refer to Exhibit C16-3)	1.44	1.48	1.40
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.10	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.954	0.910	0.757

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	74	40	67	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	29.0	31.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.473	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	571			
v/c ratio from Capacity Worksheet, X	0.68			
Protected phase effective green interval, g (s)	16.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	29.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.16			
Protected ph. departure rate, Sp=s/3600	0.563			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.42			
XPerm	0.97			
XProt				
Case	4			
Queue at beginning of green arrow, Qa	0.00			
Queue at beginning of unsaturated green, Qu	7.14			
Residual queue, Qr	0.00			
Uniform Delay, d1	18.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand	Dur. Unmet Demand	Uniform Delay		Initial Queue	Final Unmet	Initial	Lane
	Q veh	t hrs.	Unadj. ds	Adj. d1 sec	Param. u	Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
DefL	0.0	0.00		18.1	0.00	0.0	0.0	22.2
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	19.8	0.00	0.0	0.0	19.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.1
R	0.0	0.00	19.5	19.5	0.00	26.2	0.0	86.3
Intersection Delay			58.0	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	571	40			38				8				67	1002	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1691	2132			1639				1647				1410	1583	
LnCapacity	845	1066			564				640				548	897	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.6	
v/c Ratio	0.68	0.04			0.07				0.01				0.12	1.12	
Grn Ratio	0.50	0.50			0.34				0.39				0.39	0.57	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	8.1	0.5			0.6				0.1				1.1	25.0	
kB	1.0	1.1			0.8				0.8				0.7	1.0	
Q2	1.9	0.0			0.1				0.0				0.1	19.5	
Q Average	10.0	0.6			0.7				0.1				1.2	44.5	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	12.2	0.7			0.9				0.2				1.5	53.5	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	14.4	0.9			1.2				0.2				1.9	62.4	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			1.9				2.0				1.9	1.5	
BOQ	15.7	1.1			1.3				0.3				2.2	66.8	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.4	1.6	
BOQ	17.4	1.4			1.7				0.3				2.8	71.3	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.0				3.2				2.9	1.7	
BOQ	19.1	1.7			2.1				0.4				3.4	75.7	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/10/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	71	0		473	76		4			23	764	52
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	27.0					23.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	846	1881	0.17	0.45	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	571	1268	0.93	0.45	39.2	D		
T	858	1906	0.10	0.45	9.7	A	35.1	D

Northbound

L	147	384	0.03	0.38	12.0	B	12.0	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	1879	4901	0.49	0.38	15.0	B	15.0	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 21.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		71	0	473	76		4			23	764	52
% Heavy Veh		1	1	3	3		1			1	1	1
PHF		0.50	0.25	0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol		36	0	133	21		1			6	210	14
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900		1900				1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	T		L				LTR	
Lane Width		12.0		13.0	13.0		10.0				11.0	
RTOR Vol			0									0
Adj Flow		142		531	85		5				922	
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.027	
Prop RTs		0.000			0.000						0.062	
Peds Bikes		0					0				0	
Buses		0		0	0		0				0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0		0.0			0.0		
Arriv. Type		3		3	3		3			3		
Unit Ext.		3.0		3.0	3.0		3.0			3.0		
I Factor		1.000			0.983			0.988		1.000		
Lost Time		2.0		2.0	2.0		2.0			2.0		
Ext of g		2.0		2.0	2.0		2.0			2.0		
Ped Min g		31.2						18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		27.0							23.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	0		473	76		4			23	764	52
PHF	0.50	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	142	0		531	85		5			25	840	57
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	142			531	85		5			922		
Prop LTs	0.000			1.000	0.000		1.000			0.027		
Prop RTs	0.000			0.000						0.062		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.991	
fLT	1.000		0.665 1.000		0.219		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1268 1906		384		4901	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	142	1881	0.08	0.45	846	0.17
Right							
Westbound							
Prot							
Perm							
Left	L	531	1268	# 0.42	0.45	571	0.93
Prot							
Perm							
Thru	T	85	1906	0.04	0.45	858	0.10
Right							
Northbound							
Prot							
Perm							
Left	L	5	384	0.01	0.38	147	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	922	4901	# 0.19	0.38	1879	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.17	0.45	9.8	1.000	846	0.50	0.4	0.0	10.2	B	10.2	B
Westbound												
L	0.93	0.45	15.6	1.000	571	0.50	23.5	0.0	39.2	D		
T	0.10	0.45	9.5	1.000	858	0.50	0.2	0.0	9.7	A	35.1	D
Northbound												
L	0.03	0.38	11.6	1.000	147	0.50	0.4	0.0	12.0	B	12.0	B
Southbound												
LTR	0.49	0.38	14.1	1.000	1879	0.50	0.9	0.0	15.0	B	15.0	B

Intersection delay = 21.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		27.0	23.0	
Effective permitted green time for LT lane group, g(s)		27.0	23.0	
Opposing effective green time, go (s)		27.0	23.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		531	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		142	922	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		8.85	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		2.37	5.64	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.55	0.62	
gq, (see Exhibit C16-4,5,6,7,8)		0.05	6.06	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		26.95	16.94	
n=Max(gq-gf)/2,0)		0.03	3.03	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.50	3.37	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.95	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.15	0.17	
gdifff=max(gq-gf,0)		0.00	6.06	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.67	0.22	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.665	0.219	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
Adjusted LT flow rate, VLT (veh/h)
Proportion of LT in LT lane group, PLT 0.000 0.000 0.027
Proportion of LT in opposing flow, PLTo
Adjusted opposing flow rate, Vo (veh/h)
Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600
Opposing lane util. factor, fLUo 1.000 1.000 0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
Opposing platoon ratio, Rpo (refer Exhibit 16-11)
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
or $flt = [fm + 0.91(N - 1)] / N^*$
Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	T	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	142		531	85	5			338	
So	1900		1900	1900	1900			1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0	3 0	
SL	1881		1268	1906	384			1799	
LnCapacity	846		571	858	147			689	
Flow Ratio	0.1		0.4	0.0	0.0			0.2	
v/c Ratio	0.17		0.93	0.10	0.03			0.49	
Grn Ratio	0.45		0.45	0.45	0.38			0.38	
I Factor	1.000			0.983		0.988		1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	1.4		8.4	0.8	0.1			4.3	
kB	0.8		0.6	0.8	0.2			0.7	
Q2	0.2		4.1	0.1	0.0			0.6	
Q Average	1.6		12.5	0.9	0.1			4.9	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3			1.2	
BOQ	2.0		15.1	1.2	0.1			6.1	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.4	1.7	1.7			1.5	
BOQ	2.5		17.8	1.5	0.1			7.4	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.5	1.9	2.0			1.7	
BOQ	2.9		19.3	1.7	0.1			8.3	
QSRatio									
95th Percentile Output:									
fB%	2.3		1.7	2.4	2.6			2.0	
BOQ	3.6		21.0	2.2	0.2			9.7	
QSRatio									
98th Percentile Output:									
fB%	2.8		1.8	3.0	3.2			2.3	
BOQ	4.4		22.8	2.7	0.2			11.1	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/8/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	192	287	176	8	66	9	484	105	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0					27.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	616	1608	0.92	0.38	38.1	D	33.1	C
R	613	1599	0.24	0.38	13.5	B		

Westbound

LTR	581	1515	0.16	0.38	12.8	B	12.8	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2140	4756	0.31	0.45	10.9	B	10.9	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 21.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	192	287	176	8	66	9	484	105	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	56	84	52	2	19	3	136	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		564	145		95			664				
%InSharedLn												
Prop LTs		0.401			0.095			0.819				
Prop RTs		0.000	1.000		0.105			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		23.0						27.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	192	287	176	8	66	9	484	105	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	226	338	145	9	76	10	544	118	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow		564	145		95			664				
Prop LTs		0.401			0.095			0.819				
Prop RTs	0.000	1.000		0.105			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		0.990			0.990				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.986			1.000				
fLT	0.827			0.949			0.961				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1608	1599		1515			4756				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 21.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	23.0	23.0		
Effective permitted green time for LT lane group, g(s)	23.0	23.0		
Opposing effective green time, go (s)	23.0	23.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	226	9	
Proportion of LT in LT lane group, PLT	0.401	0.095	0.819
Proportion of LT in opposing flow, PLTo	0.09	0.40	
Adjusted opposing flow rate, Vo (veh/h)	95	564	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.77	0.15	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.58	9.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	13.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.62	0.62	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	11.32	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.00	9.66	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.91	0.60	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.40	0.09	
EL1 (refer to Exhibit C16-3)	1.52	2.45	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.12	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.827	0.949	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	23.0	23.0	27.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	11.32		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.492		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	95	564	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.401	0.095	0.819	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	23.0	23.0	27.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	23.0	23.0	27.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.105	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	18.5	17.6	0.00	0.0	0.0	38.1
R	0.0	0.00	18.5	12.5	0.00	0.0	0.0	13.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	12.2	0.00	0.0	0.0	12.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	16.5	10.5	0.00	0.0	0.0	10.9
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			21.7	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	564	145	95	243			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1608	1599	1515	1745			
LnCapacity	616	613	581	785			
Flow Ratio	0.4	0.1	0.1	0.1			
v/c Ratio	0.92	0.24	0.16	0.31			
Grn Ratio	0.38	0.38	0.38	0.45			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	8.9	1.6	1.0	2.6			
kB	0.6	0.6	0.6	0.7			
Q2	4.1	0.2	0.1	0.3			
Q Average	13.0	1.8	1.2	2.9			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	15.7	2.3	1.5	3.6			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.6			
BOQ	18.5	2.9	1.9	4.6			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.8	1.9	1.8			
BOQ	20.0	3.4	2.2	5.2			
QSRatio							
95th Percentile Output:							
fB%	1.7	2.3	2.4	2.2			
BOQ	21.8	4.2	2.8	6.3			
QSRatio							
98th Percentile Output:							
fB%	1.8	2.7	2.9	2.5			
BOQ	23.6	5.0	3.3	7.4			
QSRatio							

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		179	282	482	274	104	206		499	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		11.5		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	9.0	16.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	250	1668	0.02	0.15	21.8	C	40.8	D
R	248	1652	0.76	0.15	41.2	D		
Westbound								
LTR	1252	4694	0.94	0.27	30.3	C	30.3	C
Northbound								
L	227	681	0.50	0.33	23.1	C		
T	616	1848	0.36	0.33	16.7	B	18.8	B
Southbound								
TR	1122	3367	0.52	0.33	17.6	B	17.6	B

Intersection Delay = 26.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		179	282	482	274	104	206		499	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		47	80	137	78	28	56		143	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			11.5	
RTOR Vol			0			0						0
Adj Flow	4		188		1179		113	224			580	
%InSharedLn												
Prop LTS					0.271		1.000	0.000			0.000	
Prop RTS			1.000		0.264			0.000			0.010	
Peds Bikes	0	0		0	0					0	0	
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		9.0	16.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		179	282	482	274	104	206		499	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		188	320	548	311	113	224		574	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
Lane group	L		R			LTR	L		T			TR
Adj flow	4		188			1179	113	224				580
Prop LTs						0.271	1.000	0.000				0.000
Prop RTs			1.000			0.264		0.000				0.010

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	TR	L	T	L	TR
So	1900	1900	1900		1900	1900		1900
Lanes	1	0	1	0	3	0	1	2
fW	0.933	1.033	0.967		1.000	1.000		0.983
fHV	0.990	0.990	0.990		0.980	0.980		0.962
fG	1.000	1.000	1.000		1.000	1.000		1.000
fP	1.000	1.000	1.000		1.000	1.000		1.000
fBB	1.000	1.000	1.000		1.000	0.992		0.986
fA	1.000	1.000	1.000		1.000	1.000		1.000
fLU	1.000	1.000	0.908		1.000	1.000		0.952
fRT		0.850	0.960			1.000		0.998
fLT	0.950		0.987		0.366	1.000		1.000
Sec.								
fLpb	1.000		1.000		1.000	1.000		1.000
fRpb		1.000	1.000			1.000		1.000
S	1668	1652	4694		681	1848		3367
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.15	250	0.02
Prot							
Perm							
Thru							
Right	R	188	1652	# 0.11	0.15	248	0.76
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1179	4694	# 0.25	0.27	1252	0.94
Right							
Northbound							
Prot							
Perm							
Left	L	113	681	0.17	0.33	227	0.50
Prot							
Perm							
Thru	T	224	1848	0.12	0.33	616	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	580	3367	# 0.17	0.33	1122	0.52
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.54
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.15	21.7	1.000	250	0.50	0.1	0.0	21.8	C	40.8	D	
R	0.76	0.15	24.5	1.000	248	0.50	16.7	0.0	41.2	D			
Westbound													
LTR	0.94	0.27	21.5	1.000	1252	0.50	8.7	0.0	30.3	C	30.3	C	
Northbound													
L	0.50	0.33	16.0	1.000	227	0.50	7.1	0.0	23.1	C	18.8	B	
T	0.36	0.33	15.2	1.000	616	0.50	1.5	0.0	16.7	B			
Southbound													
TR	0.52	0.33	16.1	1.000	1122	0.50	1.5	0.0	17.6	B	17.6	B	

Intersection delay = 26.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			113	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			580	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			1.88	
Opposing lane util. factor, fLUo	0.908		0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			5.08	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			3.15	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.85	
n=Max(gq-gf)/2,0)			1.57	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.30	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.37	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.366	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.271 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			3.15	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.157	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			580	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	16.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.264	0.010
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	25.5	21.7	0.00	0.0	0.0	21.8
	0.0						0.0	
R	0.0	0.00	25.5	24.5	0.00	0.0	0.0	41.2
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.0	21.5	0.00	0.0	0.0	30.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.0	0.00	0.0	0.0	23.1
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.1	0.00	0.0	0.0	17.6
	0.0						0.0	

Intersection Delay	26.2	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	4	188	432	113	224	304
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	2 0
SL	1668	1652	1723	681	1848	1768
LnCapacity	250	248	459	227	616	589
Flow Ratio	0.0	0.1	0.3	0.2	0.1	0.2
v/c Ratio	0.02	0.76	0.94	0.50	0.36	0.52
Grn Ratio	0.15	0.15	0.27	0.33	0.33	0.33
I Factor		0.848	0.500		0.930	0.865
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	3.0	7.0	1.5	2.8	4.1
kB	0.3	0.3	0.2	0.3	0.6	0.5
Q2	0.0	0.8	2.4	0.3	0.3	0.5
Q Average	0.1	3.8	9.4	1.8	3.2	4.6
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.2	1.2	1.3	1.3	1.2
BOQ	0.1	4.7	11.4	2.3	4.0	5.7
QSRatio						
85th Percentile Output:						
fB%	1.7	1.5	1.4	1.6	1.6	1.5
BOQ	0.1	5.8	13.6	2.9	4.9	7.0
QSRatio						
90th Percentile Output:						
fB%	2.0	1.7	1.6	1.9	1.8	1.7
BOQ	0.1	6.6	14.8	3.3	5.6	7.8
QSRatio						
95th Percentile Output:						
fB%	2.6	2.1	1.8	2.3	2.1	2.0
BOQ	0.2	7.8	16.5	4.1	6.7	9.2
QSRatio						
98th Percentile Output:						
fB%	3.2	2.4	1.9	2.8	2.5	2.3
BOQ	0.2	9.1	18.1	4.9	7.9	10.6
QSRatio						

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	13	20	266	29	109	18	319	174	93	454	10
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 618 1426 0.09 0.43 15.3 B 15.3 B

Westbound

L 545 1257 0.56 0.43 22.9 C
 T 773 1783 0.04 0.43 14.8 B 20.6 C
 R 570 1316 0.22 0.43 16.8 B

Northbound

LTR 752 1651 0.74 0.46 24.5 C 24.5 C

Southbound

LTR 646 1419 0.99 0.46 39.2 D 39.2 D

Intersection Delay = 28.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	13	20	266	29	109	18	319	174	93	454	10
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	5	7	76	8	31	5	87	47	27	130	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		57		306	33	125		556			640	
%InSharedLn												
Prop LTs		0.158		1.000	0.000			0.036			0.167	
Prop RTs		0.509			0.000	1.000		0.340			0.017	
Peds Bikes		50	0		0	0		50	0		0	0
Buses		2		0	0	2		0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.905			0.663			0.229	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		39.0						41.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	13	20	266	29	109	18	319	174	93	454	10
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	19	29	306	33	125	20	347	189	107	522	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	57			306	33	125	556			640		
Prop LTs	0.158			1.000	0.000		0.036			0.167		
Prop RTs	0.509			0.000 1.000			0.340			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.954		0.998		
fLT	0.976		0.720	1.000		0.969		0.766		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.997		
fRpb	0.971		1.000 1.000			0.981		1.000		
S	1426		1257	1783	1316	1651		1419		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1426	0.04	0.43	618	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	306	1257	# 0.24	0.43	545	0.56
Prot							
Perm							
Thru	T	33	1783	0.02	0.43	773	0.04
Right	R	125	1316	0.09	0.43	570	0.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	556	1651	0.34	0.46	752	0.74
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	640	1419	# 0.45	0.46	646	0.99
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.43	15.1	1.000	618	0.50	0.3	0.0	15.3	B	15.3	B
Westbound												
L	0.56	0.43	19.1	1.000	545	0.50	3.8	0.0	22.9	C		
T	0.04	0.43	14.7	1.000	773	0.50	0.1	0.0	14.8	B	20.6	C
R	0.22	0.43	16.0	1.000	570	0.50	0.8	0.0	16.8	B		
Northbound												
LTR	0.74	0.46	20.1	1.000	752	0.50	4.3	0.0	24.5	C	24.5	C
Southbound												
LTR	0.99	0.46	24.3	1.000	646	0.50	14.9	0.0	39.2	D	39.2	D

Intersection delay = 28.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	107
Proportion of LT in LT lane group, PLT	0.158	0.000	0.036
Proportion of LT in opposing flow, PLTo	0.00	0.17	0.04
Adjusted opposing flow rate, Vo (veh/h)	33	640	556
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.82	16.00	13.90
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.8	18.5	3.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57	0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00	16.45	14.27
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.19	22.49	26.73
n=Max(gq-gf)/2,0)	0.00	0.00	5.48
PTHo=1-PLTo	1.00	0.83	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.17
EL1 (refer to Exhibit C16-3)	1.42	2.64	2.43
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.06
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.96
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.976	0.969	0.766

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	16.45	14.27
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.401	0.348
OCCpedu	0.000	0.058	0.000	0.045
Opposing flow rate, Vo (veh/h)	33	57	640	556
OCCr	0.000	0.053	0.000	0.021
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.979
Proportion of left turns, PLT	0.158	1.000	0.036	0.167
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.997
Permitted Right Turns				
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.509	1.000	0.340	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.981	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.5	15.1	0.00	0.0	0.0 0.0 0.0	15.3
Westbound								
L	0.0	0.00	25.5	19.1	0.00	0.0	0.0	22.9
T	0.0	0.00	25.5	14.7	0.00	0.0	0.0	14.8
R	0.0	0.00	25.5	16.0	0.00	0.0	0.0	16.8
Northbound								
LTR	0.0 0.0 0.0	0.00	24.5	20.1	0.00	0.0	0.0 0.0 0.0	24.5
Southbound								
LTR	0.0 0.0 0.0	0.00	24.5	24.3	0.00	0.0	0.0 0.0 0.0	39.2
Intersection Delay			28.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	57		306	33	125	556		640	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1426		1257	1783	1316	1651		1419	
LnCapacity	618		545	773	570	752		646	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.5	
v/c Ratio	0.09		0.56	0.04	0.22	0.74		0.99	
Grn Ratio	0.43		0.43	0.43	0.43	0.46		0.46	
I Factor	1.000		0.905			0.663		0.229	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.8		5.7	0.5	2.0	11.4		15.9	
kB	0.8		0.7	0.9	0.7	0.6		0.2	
Q2	0.1		0.8	0.0	0.2	1.6		3.6	
Q Average	0.9		6.6	0.5	2.2	13.1		19.4	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	1.2		8.1	0.7	2.7	15.8		23.4	
QSRatio									
85th Percentile Output:									
fB%	1.6		1.5	1.7	1.6	1.4		1.4	
BOQ	1.5		9.7	0.9	3.4	18.6		27.3	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.5		1.5	
BOQ	1.8		10.7	1.0	3.9	20.1		29.4	
QSRatio									
95th Percentile Output:									
fB%	2.4		1.9	2.5	2.3	1.7		1.6	
BOQ	2.2		12.3	1.3	4.8	21.9		31.5	
QSRatio									
98th Percentile Output:									
fB%	2.9		2.1	3.1	2.7	1.8		1.7	
BOQ	2.7		13.8	1.6	5.8	23.6		33.7	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 10/7/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Conditions
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	210	252		227	231		144		217			
Lane Width	16.0			10.0	10.0		11.0					
RTOR Vol		59						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P	P			SB Left			
	Thru	P	P			Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		33.0	6.0				38.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	689	1880	0.71	0.37	30.2	C	30.2	C
----	-----	------	------	------	------	---	------	---

Westbound

L	327	1560	0.83	0.47	53.6	D		
T	766	1642	0.36	0.47	16.7	B	35.0-	C

Northbound

LR	605	1433	0.89	0.42	40.7	D	40.7	D
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Southbound

Intersection Delay = 35.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		210	252	227	231		144		217			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		64	77	68	70		54		81			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		10.0	10.0			11.0				
RTOR Vol			59						0			
Adj Flow		491		273	278			539				
%InSharedLn												
Prop LTS		0.000		1.000	0.000			0.399				
Prop RTS		0.479			0.000			0.601				
Peds Bikes	0						0			0		
Buses		5		0	0			0				
%InProtPhase				0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P		P			SB	Left		
	Thru	P		P				Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		33.0	6.0					38.0		
Yellow		3.0	3.0					3.0		
All Red		0.0	2.0					2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		210	252		227	231		144	217			
PHF		0.82	0.82		0.83	0.83		0.67	0.67			
Adj flow		256	235		273	278		215	324			
No. Lanes	0	1	0		1	1	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		491			273	278		539				
Prop LTs		0.000			1.000	0.000		0.399				
Prop RTs		0.479			0.000			0.601				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1	0	0	0	0
fW	1.133		0.933	0.933		0.967		
fHV	0.952		0.926	0.926		0.990		
fG	1.000		1.000	1.000		1.000		
fP	1.000		1.000	1.000		0.875		
fBB	0.980		1.000	1.000		1.000		
fA	1.000		1.000	1.000		1.000		
fLU	1.000		1.000	1.000		1.000		
fRT	0.935			1.000		0.919		
fLT	1.000		0.950	1.000		0.980		
Sec.			0.241					
fLpb	1.000		1.000	1.000		1.000		
fRpb	1.000			1.000		1.000		
S	1880		1560	1642		1433		
Sec.			396					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.71	0.37	24.4	1.000	689	0.50	5.7	0.0	30.2	C	30.2	C
Westbound												
L	0.83	0.47	32.2	1.000	327	0.50	21.4	0.0	53.6	D		
T	0.36	0.47	15.4	1.000	766	0.50	1.3	0.0	16.7	B	35.0-	C
Northbound												
LR	0.89	0.42	24.1	1.000	605	0.50	16.6	0.0	40.7	D	40.7	D
Southbound												

Intersection delay = 35.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		90.0	sec	
Total actual green time for LT lane group, G (s)		42.0		
Effective permitted green time for LT lane group, g(s)		31.0		
Opposing effective green time, go (s)		33.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		273		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		491		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		6.83		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		12.27		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.63		
gq, (see Exhibit C16-4,5,6,7,8)		15.58		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.42		
n=Max(gq-gf)/2,0)		7.79		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.07		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.13		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.24		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.241		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		90.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.399
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	273			
v/c ratio from Capacity Worksheet, X	0.83			
Protected phase effective green interval, g (s)	11.0			
Opposing queue effective green interval, gq	15.58			
Unopposed green interval, gu	15.42			
Red time r=(C-g-gq-gu)	48.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08			
Protected ph. departure rate, Sp=s/3600	0.433			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22			
XPerm	1.76			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	2.58			
Queue at beginning of unsaturated green, Qu	4.82			
Residual queue, Qr	0.00			
Uniform Delay, d1	32.2			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	28.5	24.4	0.00	0.0	0.0	30.2
	0.0						0.0	
Westbound								
L	0.0	0.00		32.2	0.00	0.0	0.0	53.6
T	0.0	0.00	24.0	15.4	0.00	0.0	0.0	16.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	26.0	24.1	0.00	0.0	0.0	40.7
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	

Intersection Delay	35.4	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	TR			L	T		LR					
Init Queue	0.0			0.0	0.0		0.0					
Flow Rate	491			273	278		539					
So	1900			1900	1900		1900					
No.Lanes	0	1	0	1	1	0	0	0	0	0	0	0
SL	1880			701	1642		1433					
LnCapacity	689			327	766		605					
Flow Ratio	0.3			0.4	0.2		0.4					
v/c Ratio	0.71			0.83	0.36		0.89					
Grn Ratio	0.37			0.47	0.47		0.42					
I Factor	0.927				0.989		0.917					
AT or PVG	3			3	3		3					
Pltn Ratio	1.00			1.00	1.00		1.00					
PF2	1.00			1.00	1.00		1.00					
Q1	10.5			4.1	4.5		12.5					
kB	0.8			0.5	0.9		0.7					
Q2	1.9			2.0	0.5		4.0					
Q Average	12.4			6.1	5.0		16.5					
Q Spacing	25.0			25.0	25.0		25.0					
Q Storage	0			0	0		0					
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.2	1.2		1.2					
BOQ	15.0			7.5	6.2		19.9					
QSRatio												
85th Percentile Output:												
fB%	1.4			1.5	1.5		1.4					
BOQ	17.7			9.0	7.5		23.3					
QSRatio												
90th Percentile Output:												
fB%	1.5			1.6	1.7		1.5					
BOQ	19.1			10.0	8.4		25.1					
QSRatio												
95th Percentile Output:												
fB%	1.7			1.9	2.0		1.6					
BOQ	20.9			11.5	9.8		27.0					
QSRatio												
98th Percentile Output:												
fB%	1.8			2.1	2.3		1.8					
BOQ	22.6			13.0	11.2		29.0					
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			330	55		19	388	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			358	59		21	440	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided				/		
RT Channelized?								
Lanes			1	0			0	1
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		119		22				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		158		29				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage						/		
Lanes		1		1				
Configuration		L		R				

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9		10	11	12
Lane Config		LT	L		R				
v (vph)		21	158		29				
C(m) (vph)		1126	315		658				
v/c		0.02	0.50		0.04				
95% queue length		0.06	2.66		0.14				
Control Delay		8.3	27.4		10.7				
LOS		A	D		B				
Approach Delay				24.8					
Approach LOS				C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		330	55	19	388	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		90	15	5	110	
Hourly Flow Rate, HFR		358	59	21	440	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	119		22			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	40		7			
Hourly Flow Rate, HFR	158		29			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		440
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		417	870		388			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	388	
Potential Capacity	658	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	658	
Probability of Queue free St.	0.96	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	417	
Potential Capacity	1126	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1126	
Probability of Queue free St.	0.98	1.00
Maj L-Shared Prob Q free St.	0.97	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	870	
Potential Capacity	321	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.98	0.94
Movement Capacity	315	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 870
Potential Capacity 321
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.97
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.98 0.94
Movement Capacity 315

Results for Two-stage process:
a
y
C t 315

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	158		29			
Movement Capacity (vph)	315		658			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	315		658			
Volume	158		29			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT	L		R			
v (vph)		21	158		29			
C(m) (vph)		1126	315		658			
v/c		0.02	0.50		0.04			
95% queue length		0.06	2.66		0.14			
Control Delay		8.3	27.4		10.7			
LOS		A	D		B			
Approach Delay				24.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.98
v(i1), Volume for stream 2 or 5		440
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.97
d(M,LT), Delay for stream 1 or 4		8.3
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.2

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	0	10	5	430	27	443	5	215	421	307	228	0
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	726	1743	0.02	0.42	10.4	B	10.4	B
Westbound								
LT	545	1309	0.91	0.42	35.7	D	34.8	C
R	539	1293	0.89	0.42	33.8	C		
Northbound								
LT	744	1785	0.32	0.42	12.8	B	17.9	B
R	641	1538	0.72	0.42	20.6	C		
Southbound								
L	430	1031	0.78	0.42	28.5	C		
TR	737	1769	0.34	0.42	13.2	B	21.9	C

Intersection Delay = 26.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	430	27	443	5	215	421	307	228	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	117	7	120	2	59	116	84	63	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900		1900	1900
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			496	482		241	463	337	251	
%InSharedLn												
Prop LTs		0.000			0.942			0.021		1.000	0.000	
Prop RTs		0.313			0.000	1.000		0.000	1.000		0.000	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		2	0	0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	430	27	443	5	215	421	307	228	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	467	29	482	5	236	463	337	251	0
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	16			496 482			241 463			337 251		
Prop LTs	0.000			0.942			0.021			1.000 0.000		
Prop RTs	0.313			0.000 1.000			0.000 1.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.980			0.980 0.980			0.952 0.952			0.971 0.971		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.992 1.000			1.000 0.992		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.958			1.000 0.850			1.000 0.850			1.000		
fLT	1.000			0.727			0.995			0.599 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1743			1309 1293			1785 1538			1031 1769		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	496	1309	# 0.38	0.42	545	0.91
Right	R	482	1293	0.37	0.42	539	0.89
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	241	1785	0.14	0.42	744	0.32
Right	R	463	1538	0.30	0.42	641	0.72
Southbound							
Prot							
Perm							
Left	L	337	1031	# 0.33	0.42	430	0.78
Prot							
Perm							
Thru	TR	251	1769	0.14	0.42	737	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.91	0.42	16.4	1.000	545	0.50	19.2	0.0	35.7	D	34.8	C
R	0.89	0.42	16.3	1.000	539	0.50	17.5	0.0	33.8	C		
Northbound												
LT	0.32	0.42	11.8	1.000	744	0.50	1.0	0.0	12.8	B	17.9	B
R	0.72	0.42	14.6	1.000	641	0.50	6.0	0.0	20.6	C		
Southbound												
L	0.78	0.42	15.2	1.000	430	0.50	13.3	0.0	28.5	C		
TR	0.34	0.42	11.9	1.000	737	0.50	1.3	0.0	13.2	B	21.9	C

Intersection delay = 26.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				337
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				241
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.62
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.02
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				0.41
gu=g-gq if gq>=gf, or = g-gf if gq<gf				24.59
n=Max(gq-gf)/2,0)				0.21
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.64
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.16
gdifff=max(gq-gf,0)				0.41
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.60
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.599

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	0	467	5	
Proportion of LT in LT lane group, PLT	0.000	0.942	0.021	0.000
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	496	16	251	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.78	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.27	0.27	4.18	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	16.6	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	8.95	0.00	0.67	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.05	25.00	8.45	
n=Max(gq-gf)/2,0)	4.48	0.00	0.00	
PTHo=1-PLTo	0.06	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.02	
EL1 (refer to Exhibit C16-3)	2.29	1.40	1.79	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.06			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.16	0.08	
gdifff=max(gq-gf,0)	8.95	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.73	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.727	0.995	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.95		0.67	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.358		0.027	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	496		251	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.021	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.4	0.00	0.0	0.0	35.7
R	0.0	0.00	17.5	16.3	0.00	0.0	0.0	33.8
Northbound								
	0.0						0.0	
LT	0.0	0.00	17.5	11.8	0.00	0.0	0.0	12.8
R	0.0	0.00	17.5	14.6	0.00	0.0	0.0	20.6
Southbound								
L	0.0	0.00	17.5	15.2	0.00	0.0	0.0	28.5
TR	0.0	0.00	17.5	11.9	0.00	0.0	0.0	13.2
	0.0						0.0	

Intersection Delay	26.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16		496	482	241	463	337	251
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	0	
SL	1743		1309	1293	1785	1538	1031	1769
LnCapacity	726		545	539	744	641	430	737
Flow Ratio	0.0		0.4	0.4	0.1	0.3	0.3	0.1
v/c Ratio	0.02		0.91	0.89	0.32	0.72	0.78	0.34
Grn Ratio	0.42		0.42	0.42	0.42	0.42	0.42	0.42
I Factor	1.000		0.849		0.861		1.000	
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2		7.8	7.5	2.7	6.4	4.9	2.8
kB	0.7		0.5	0.5	0.6	0.5	0.5	0.7
Q2	0.0		3.2	2.9	0.3	1.3	1.5	0.4
Q Average	0.2		10.9	10.3	3.0	7.8	6.4	3.2
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.3
BOQ	0.2		13.3	12.5	3.8	9.5	7.8	4.0
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.4	1.6	1.5	1.5	1.6
BOQ	0.3		15.7	14.9	4.7	11.4	9.5	5.0
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.8	1.6	1.6	1.8
BOQ	0.3		17.0	16.1	5.3	12.5	10.5	5.6
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	1.7	2.1	1.8	1.9	2.1
BOQ	0.4		18.7	17.8	6.4	14.1	12.0	6.8
QSRatio								
98th Percentile Output:								
fB%	3.1		1.9	1.9	2.5	2.0	2.1	2.5
BOQ	0.5		20.5	19.5	7.6	15.7	13.5	8.0
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 10/7/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				107		232	652	93		165	743	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 392 1471 0.97 0.27 59.4 E 59.4 E

Northbound

TR 1132 1998 0.72 0.57 12.7 B 12.7 B

Southbound

L 249 440 0.73 0.57 14.6 B
 T 977 1725 0.84 0.57 13.2 B 13.4 B

Intersection Delay = 21.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 10/7/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				107		232	652	93		165	743	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				30		65	179	26		45	204	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					381			818		181	816	
%InSharedLn												
Prop LTs					0.315			0.000		1.000	0.000	
Prop RTs					0.685			0.125			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet					0.0			0.0		0.0	0.0	
Arriv. Type					3			3		3	3	
Unit Ext.					3.0			3.0		3.0	3.0	
I Factor					0.940			0.789			0.272	
Lost Time					2.0			2.0		2.0	2.0	
Ext of g					2.0			2.0		2.0	2.0	
Ped Min g		11.8			11.8			14.1				

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				107		232	652	93		165	743	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				120		261	716	102		181	816	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					381			818		181	816	
Prop LTs					0.315			0.000		1.000	0.000	
Prop RTs					0.685			0.125			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.990			0.980			0.980	0.980	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.992			1.000	0.992	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.908			0.983				1.000	
fLT				0.984			1.000			0.253	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1471			1998			440	1725	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	381	1471	# 0.26	0.27	392	0.97
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	818	1998	0.41	0.57	1132	0.72
Right							
Southbound							
Prot							
Perm							
Left	L	181	440	0.41	0.57	249	0.73
Prot							
Perm							
Thru	T	816	1725	# 0.47	0.57	977	0.84
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.97	0.27	21.8	1.000	392	0.50	37.6	0.0	59.4	E	59.4	E
Northbound												
TR	0.72	0.57	9.5	1.000	1132	0.50	3.2	0.0	12.7	B	12.7	B
Southbound												
L	0.73	0.57	9.6	1.000	249	0.50	5.0	0.0	14.6	B		
T	0.84	0.57	10.7	1.000	977	0.50	2.5	0.0	13.2	B	13.4	B

Intersection delay = 21.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				181
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				818
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.02
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				13.63
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				9.90
gu=g-gq if gq>=gf, or = g-gf if gq<gf				24.10
n=Max(gq-gf)/2,0)				4.95
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.80
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.25
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.253

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.315 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				9.90
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.291
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				818
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.685	0.125
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.8	0.00	0.0	0.0	59.4
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.5	0.00	0.0	0.0	12.7
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	9.6	0.00	0.0	0.0	14.6
T	0.0	0.00	13.0	10.7	0.00	0.0	0.0	13.2
	0.0						0.0	

Intersection Delay	21.1	sec/veh	Intersection LOS	C
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					381		818	181	816
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1471		1998	440	1725
LnCapacity					392		1132	249	977
Flow Ratio					0.3		0.4	0.4	0.5
v/c Ratio					0.97		0.72	0.73	0.84
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.940		0.789		0.272
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					6.3		10.0	2.2	11.2
kB					0.4		0.7	0.1	0.2
Q2					3.8		1.8	0.2	1.1
Q Average					10.1		11.8	2.5	12.3
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					12.3		14.3	3.1	14.9
QSRatio									
85th Percentile Output:									
fB%					1.4		1.4	1.6	1.4
BOQ					14.6		16.9	3.9	17.5
QSRatio									
90th Percentile Output:									
fB%					1.6		1.5	1.8	1.5
BOQ					15.9		18.3	4.4	19.0
QSRatio									
95th Percentile Output:									
fB%					1.7		1.7	2.2	1.7
BOQ					17.5		20.1	5.4	20.7
QSRatio									
98th Percentile Output:									
fB%					1.9		1.8	2.6	1.8
BOQ					19.2		21.8	6.4	22.5
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Volume	176	428	227	272	679	102	232	479	221	243	140	159
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0

Duration		0.25		Area Type: All other areas										
		Signal Operations												
Phase Combination		1	2	3	4			5	6	7	8			
EB	Left	P	P				NB	Left	P	P				
	Thru	P			Thru			P	P					
	Right	P			Right			P	P					
	Peds				Peds									
WB	Left	P	P				SB	Left		P	P			
	Thru	P			Thru				P	P				
	Right	P			Right				P	P				
	Peds	X			Peds									
NB	Right		P				EB	Right						
SB	Right				WB		Right							
Green		27.0	6.0					16.0	11.0	11.0				
Yellow		3.0	3.0					3.0	3.0	3.0				
All Red		0.0	2.0					0.0	0.0	2.0				
												Cycle Length: 90.0		secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	292	1728	0.65	0.40	42.3	D		
T	564	1881	0.82	0.30	38.1	D	36.6	D
R	448	1492	0.43	0.30	27.4	C		
Westbound								
L	302	1765	0.94	0.41	71.8	E		
TR	1073	3450	0.92	0.31	42.9	D	49.3	D
Northbound								
DefL	402	1787	0.64	0.33	31.7	C		
T	638	1913	0.83	0.33	39.9	D	32.5	C
R	680	1492	0.36	0.46	17.5	B		
Southbound								
L	392	1728	0.74	0.28	41.8	D		
TR	449	1616	0.79	0.28	41.8	D	41.8	D

Intersection Delay = 40.6 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	176	428	227	272	679	102	232	479	221	243	140	159
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	115	61	71	218	33	64	133	61	72	42	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	189	460	192	283	988		258	532	246	289	356	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.000	1.000		0.118			0.000	1.000		0.531	
Peds Bikes	0			0	0	0	0			0		
Buses	0	0	0	0	0		0	0	0	0	0	
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
I Factor		0.700			0.903			1.000			0.855	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0	2.0	2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds							Peds		
WB	Left	P		P			SB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds		
NB	Right			P			EB	Right		
SB	Right						WB	Right		
Green		27.0	6.0					16.0	11.0	11.0
Yellow		3.0	3.0					3.0	3.0	3.0
All Red		0.0	2.0					0.0	0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	176	428	227	272	679	102	232	479	221	243	140	159
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	189	460	192	283	871	117	258	532	246	289	167	189
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR		DefL	T	R	L	TR	
Adj flow	189	460	192	283	988		258	532	246	289	356	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.118			0.000	1.000		0.531	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		DefL	T	R	L	TR	
So	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
Lanes	1	1	1	1	2	0	0	2	1	1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.000	1.017	0.933	0.967	0.933	
fHV	0.990	0.990	0.990	0.971	0.971		0.990	0.990	0.990	0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		0.982			1.000	0.850		0.920	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.160			0.160			0.286			0.466		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000	1.000		1.000	
S	1728	1881	1492	1765	3450		1787	1913	1492	1728	1616	
Sec.	291			298			537			848		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		108	1728	0.06	0.122	211	0.51
Perm		81	291	0.28	0.278	81	1.00
Left	L	189			0.40	292	0.65
Prot							
Perm							
Thru	T	460	1881	0.24	0.30	564	0.82
Right	R	192	1492	0.13	0.30	448	0.43
Westbound							
Prot		197	1765	# 0.11	0.122	216	0.91
Perm		86	298	# 0.29	0.289	86	1.00
Left	L	283			0.41	302	0.94
Prot							
Perm							
Thru	TR	988	3450	0.29	0.31	1073	0.92
Right							
Northbound							
Prot		258	1787	0.14	0.178	318	0.81
Perm		0	537	0.00	0.156	84	0.00
Left	DefL	258			0.33	402	0.64
Prot							
Perm							
Thru	T	532	1913	# 0.28	0.33	638	0.83
Right	R	246	1492	0.16	0.46	680	0.36
Southbound							
Prot		204	1728	0.12	0.178	307	0.66
Perm		85	848	0.10	0.100	85	1.00
Left	L	289			0.28	392	0.74
Prot							
Perm							
Thru	TR	356	1616	# 0.22	0.28	449	0.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.90

Total lost time per cycle, L = 12.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.65	0.40	34.7	1.000	292	0.50	7.6	0.0	42.3	D		
T	0.82	0.30	29.2	1.000	564	0.50	8.9	0.0	38.1	D	36.6	D
R	0.43	0.30	25.3	1.000	448	0.50	2.1	0.0	27.4	C		
Westbound												
L	0.94	0.41	36.2	1.000	302	0.50	35.5	0.0	71.8	E		
TR	0.92	0.31	29.9	1.000	1073	0.50	12.9	0.0	42.9	D	49.3	D
Northbound												
DefL	0.64	0.33	24.0	1.000	402	0.50	7.7	0.0	31.7	C		
T	0.83	0.33	27.7	1.000	638	0.50	12.2	0.0	39.9	D	32.5	C
R	0.36	0.46	16.0	1.000	680	0.50	1.5	0.0	17.5	B		
Southbound												
L	0.74	0.28	31.6	1.000	392	0.50	10.1	0.0	41.8	D		
TR	0.79	0.28	30.1	1.000	449	0.50	11.7	0.0	41.8	D	41.8	D

Intersection delay = 40.6 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	36.0	36.0	30.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	26.0	14.0	9.0
Opposing effective green time, go (s)	28.0	27.0	25.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	1	1	2
Adjusted LT flow rate, VLT (veh/h)	189	283	258	289
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	988	460	356	532
Lost time for LT lane group, tL	5.00	4.00	3.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	4.72	7.08	6.45	7.23
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.97	11.50	8.90	6.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.70	0.72	0.67
gq, (see Exhibit C16-4,5,6,7,8)	20.11	17.63	14.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.89	8.37	0.00	9.00
n=Max(gq-gf)/2,0)	10.06	8.81	7.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.44	2.01	1.82	2.15
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16	0.15	0.29	0.44
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.16	0.16	0.29	0.47
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.160	0.160	0.286	0.466

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	27.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	20.11			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.745			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	988			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		27.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		28.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.118
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	189	283	258	289
v/c ratio from Capacity Worksheet, X	0.65	0.94	0.64	0.74
Protected phase effective green interval, g (s)	11.0	11.0	16.0	16.0
Opposing queue effective green interval, gq	20.11	17.63	10.00	0.00
Unopposed green interval, gu	4.89	8.37	4.00	9.00
Red time r=(C-g-gq-gu)	54.0	53.0	60.0	65.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.08	0.07	0.08
Protected ph. departure rate, Sp=s/3600	0.480	0.490	0.496	0.480
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.41	0.26	0.52	0.24
XPerm	2.05	2.89	0.48	2.80
XProt			0.69	
Case	5	5	1	5
Queue at beginning of green arrow, Qa	2.13	4.06	4.30	3.82
Queue at beginning of unsaturated green, Qu	3.89	5.55	0.72	5.22
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	34.7	36.2	24.0	31.6

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		34.7	0.00	0.0	0.0	42.3
T	0.0	0.00	31.5	29.2	0.00	0.0	0.0	38.1
R	0.0	0.00	31.5	25.3	0.00	0.0	0.0	27.4
Westbound								
L	0.0	0.00		36.2	0.00	0.0	0.0	71.8
TR	0.0	0.00	31.0	29.9	0.00	0.0	0.0	42.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00		24.0	0.00	0.0	0.0	31.7
T	0.0	0.00	30.0	27.7	0.00	0.0	0.0	39.9
R	0.0	0.00	24.5	16.0	0.00	0.0	0.0	17.5
Southbound								
L	0.0	0.00		31.6	0.00	0.0	0.0	41.8
TR	0.0	0.00	32.5	30.1	0.00	0.0	0.0	41.8
	0.0						0.0	
Intersection Delay			40.6	sec/veh	Intersection LOS			D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	L	T	R	L	TR	DefL	T	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	189	460	192	283	518	258	532	246	289	356	
So	1900	1900	1900	2050	1900	1900	1900	1900	1900	1900	
No.Lanes	1	1	1	1	2	0	2	1	1	1	0
SL	730	1881	1492	734	1811	1204	1913	1492	1411	1616	
LnCapacity	292	564	448	302	563	402	638	680	392	449	
Flow Ratio	0.3	0.2	0.1	0.4	0.3	0.2	0.3	0.2	0.2	0.2	
v/c Ratio	0.65	0.82	0.43	0.94	0.92	0.64	0.83	0.36	0.74	0.79	
Grn Ratio	0.40	0.30	0.30	0.41	0.31	0.33	0.33	0.46	0.28	0.28	
I Factor		0.700			0.903		1.000			0.855	
AT or PVG	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	3.1	10.7	3.9	4.7	12.5	4.9	12.3	4.0	6.0	8.2	
kB	0.3	0.5	0.5	0.4	0.7	0.6	0.8	0.9	0.5	0.6	
Q2	0.6	2.0	0.3	3.0	4.4	1.0	3.3	0.5	1.3	1.8	
Q Average	3.7	12.7	4.2	7.7	16.9	5.9	15.6	4.5	7.3	10.1	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	4.6	15.3	5.2	9.4	20.4	7.2	18.8	5.6	8.9	12.2	
QSRatio											
85th Percentile Output:											
fB%	1.5	1.4	1.5	1.5	1.4	1.5	1.4	1.5	1.5	1.4	
BOQ	5.7	18.1	6.4	11.2	23.9	8.8	22.1	6.8	10.7	14.5	
QSRatio											
90th Percentile Output:											
fB%	1.7	1.5	1.7	1.6	1.5	1.7	1.5	1.7	1.6	1.6	
BOQ	6.4	19.6	7.2	12.3	25.7	9.7	23.8	7.7	11.8	15.8	
QSRatio											
95th Percentile Output:											
fB%	2.1	1.7	2.0	1.8	1.6	1.9	1.6	2.0	1.8	1.7	
BOQ	7.6	21.3	8.5	13.9	27.7	11.2	25.7	9.0	13.4	17.5	
QSRatio											
98th Percentile Output:											
fB%	2.4	1.8	2.3	2.0	1.8	2.2	1.8	2.3	2.0	1.9	
BOQ	8.9	23.1	9.8	15.5	29.7	12.7	27.6	10.4	14.9	19.2	
QSRatio											

ERROR MESSAGES

No errors to report.

Analyst: ML Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 08/19/2013 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	81	162	609	235	552	25	345	268	115	26	831	167
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	28.0	6.0				32.0	8.0	
Yellow	3.0	3.0				3.0	3.0	
All Red	0.0	2.0				0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	128	413	0.69	0.31	49.3	D		
TR	973	3126	0.86	0.31	37.6	D	38.7	D
Westbound								
DefL	301	1787	1.00	0.41	84.7	F		
TR	768	1869	0.96	0.41	48.4	D	58.9	E
Northbound								
DefL	381	1992	0.96	0.48	73.3	E		
TR	887	1857	0.47	0.48	17.7	B	43.6	D
Southbound								
L	282	794	0.10	0.36	20.1	C		
TR	1150	3233	0.93	0.36	42.8	D	42.2	D

Intersection Delay = 46.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/19/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81	162	609	235	552	25	345	268	115	26	831	167
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	22	44	165	75	177	8	92	74	32	7	223	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		2050	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	10.0	12.0		12.0	12.0		13.0	13.0		9.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	88	838		301	740		367	421		28	1074	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.790			0.043			0.299			0.168	
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0			0.0					
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds	X	X
WB	Left	P	P				SB	Left	P	
	Thru	P	P					Thru	P	
	Right	P	P					Right	P	
	Peds	X	X					Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		28.0	6.0						32.0	8.0
Yellow		3.0	3.0						3.0	3.0
All Red		0.0	2.0						0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81	162	609	235	552	25	345	268	115	26	831	167
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	88	176	662	301	708	32	367	295	126	28	894	180
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	88	838		301	740		367	421		28	1074	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.790			0.043			0.299			0.168	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		2050	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.933	1.000		1.000	1.000		1.033	1.033		0.900	0.917	
fHV	0.980	0.980		0.990	0.990		0.990	0.990		1.000	1.000	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.882			0.994			0.955			0.975	
fLT	0.237	1.000		0.950	1.000		0.950	1.000		0.464	1.000	
Sec.				0.154			0.133					
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	413	3126		1787	1869		1992	1857		794	3233	
Sec.				289			280					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	88	413	0.21	0.31	128	0.69
Prot							
Perm							
Thru	TR	838	3126	0.27	0.31	973	0.86
Right							
Westbound							
Prot		218	1787	0.12	0.122	218	1.00
Perm		83	289	0.29	0.289	83	1.00
Left	DefL	301			0.41	301	1.00
Prot							
Perm				#			
Thru	TR	740	1869	# 0.40	0.41	768	0.96
Right							
Northbound							
Prot		274	1992	0.14	0.144	288	0.95
Perm		93	280	0.33	0.333	93	1.00
Left	DefL	367			0.48	381	0.96
Prot							
Perm				#			
Thru	TR	421	1857	# 0.23	0.48	887	0.47
Right							
Southbound							
Prot							
Perm							
Left	L	28	794	0.04	0.36	282	0.10
Prot							
Perm							
Thru	TR	1074	3233	0.33	0.36	1150	0.93
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.24
Total lost time per cycle, L = 20.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.60

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.69	0.31	27.2	1.000	128	0.50	22.2	0.0	49.3	D			
TR	0.86	0.31	29.2	1.000	973	0.50	8.4	0.0	37.6	D	38.7	D	
Westbound													
DefL	1.00	0.41	36.4	1.000	301	0.50	48.2	0.0	84.7	F			
TR	0.96	0.41	25.8	1.000	768	0.50	22.6	0.0	48.4	D	58.9	E	
Northbound													
DefL	0.96	0.48	35.5	1.000	381	0.50	37.7	0.0	73.3	E			
TR	0.47	0.48	15.9	1.000	887	0.50	1.8	0.0	17.7	B	43.6	D	
Southbound													
L	0.10	0.36	19.4	1.000	282	0.50	0.7	0.0	20.1	C			
TR	0.93	0.36	28.0	1.000	1150	0.50	14.8	0.0	42.8	D	42.2	D	

Intersection delay = 46.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	28.0	37.0	43.0	32.0
Effective permitted green time for LT lane group, g(s)	28.0	26.0	30.0	32.0
Opposing effective green time, go (s)	37.0	28.0	32.0	43.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	88	301	367	28
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	740	838	1074	421
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.20	7.53	9.18	0.70
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.25	11.00	14.10	5.26
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59	0.69	0.64	0.52
gq, (see Exhibit C16-4,5,6,7,8)	10.71	15.07	21.47	3.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.29	10.93	8.53	28.78
n=Max(gq-gf)/2,0)	5.36	7.53	10.74	1.61
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.60	2.97	3.75	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.15	0.13	0.13
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.24	0.15	0.13	0.46
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.237	0.154	0.133	0.464

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	28.0	28.0		32.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	10.71	15.07		3.22
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.383	0.538		0.101
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	740	838		421
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	1.000		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	28.0	37.0	43.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	28.0	37.0	43.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.790	0.043	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	301	367		
v/c ratio from Capacity Worksheet, X	1.00	0.96		
Protected phase effective green interval, g (s)	11.0	13.0		
Opposing queue effective green interval, gq	15.07	21.47		
Unopposed green interval, gu	10.93	8.53		
Red time r=(C-g-gq-gu)	53.0	47.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08	0.10		
Protected ph. departure rate, Sp=s/3600	0.496	0.553		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.19	0.27		
XPerm	3.16	3.36		
XProt				
Case	5	5		
Queue at beginning of green arrow, Qa	4.52	5.52		
Queue at beginning of unsaturated green, Qu	5.69	6.98		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	36.4	35.5		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	31.0	27.2	0.00	0.0	0.0	49.3
TR	0.0	0.00	31.0	29.2	0.00	0.0	0.0	37.6
	0.0						0.0	
Westbound								
DefL	0.0	0.00		36.4	0.00	0.0	0.0	84.7
TR	0.0	0.00	26.5	25.8	0.00	0.0	0.0	48.4
	0.0						0.0	
Northbound								
DefL	0.0	0.00		35.5	0.00	0.0	0.0	73.3
TR	0.0	0.00	23.5	15.9	0.00	0.0	0.0	17.7
	0.0						0.0	
Southbound								
L	0.0	0.00	29.0	19.4	0.00	0.0	0.0	20.1
TR	0.0	0.00	29.0	28.0	0.00	0.0	0.0	42.8
	0.0						0.0	

Intersection Delay 46.1 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	88	440		301	740		367	421		28	564	
So	1900	1900		1900	1900		2050	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	413	1641		734	1869		798	1857		794	1698	
LnCapacity	128	511		301	768		381	887		282	603	
Flow Ratio	0.2	0.3		0.4	0.4		0.5	0.2		0.0	0.3	
v/c Ratio	0.69	0.86		1.00	0.96		0.96	0.47		0.10	0.94	
Grn Ratio	0.31	0.31		0.41	0.41		0.48	0.48		0.36	0.36	
I Factor		0.830			0.865			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	1.9	10.4		5.0	18.0		5.6	7.1		0.5	13.6	
kB	0.2	0.6		0.4	0.8		0.6	1.1		0.5	0.8	
Q2	0.5	2.8		4.0	7.1		4.4	0.9		0.1	5.5	
Q Average	2.4	13.1		9.1	25.2		9.9	8.0		0.5	19.1	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	3.0	15.9		11.0	30.2		12.1	9.8		0.7	22.9	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.4	1.4		1.4	1.5		1.7	1.4	
BOQ	3.8	18.7		13.1	35.3		14.3	11.7		0.9	26.8	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5		1.6	1.5		1.6	1.6		2.0	1.5	
BOQ	4.3	20.2		14.3	37.9		15.6	12.9		1.0	28.8	
QSRatio												
95th Percentile Output:												
fB%	2.2	1.7		1.8	1.6		1.7	1.8		2.5	1.6	
BOQ	5.3	22.0		16.0	40.5		17.3	14.5		1.3	31.0	
QSRatio												
98th Percentile Output:												
fB%	2.6	1.8		1.9	1.7		1.9	2.0		3.1	1.7	
BOQ	6.3	23.8		17.6	43.1		18.9	16.1		1.6	33.1	
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 6 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: ML

Agency: AECOM

Date: 08/29/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Sat Flw Rate EB-L = 2100

Year : 2020 FULL Mitigation

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	877	484			517	1150				241		215
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	P		
Thru		P			Thru			
Right	P	P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right	P		
Green	38.0	24.0				13.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

L	916	1909	0.99	0.76	39.3	D		
T	1225	1646	0.41	0.74	4.8	A	26.9	C

Westbound

T	502	1881	1.10	0.27	82.3	F	26.5	C
R	1599	1599	0.74	1.00	0.6	A		

Northbound

Southbound

L	468	3239	0.56	0.14	40.6	D	25.4	C
R	928	1492	0.25	0.62	8.3	A		

Intersection Delay = 26.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2020 FULL Mitigation
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	877	484		517	1150					241		215
% Heavy Veh	1	1		1	1					1		1
PHF	0.97	0.96		0.94	0.97					0.92		0.92
PK 15 Vol	226	126		138	296					65		58
Hi Ln Vol												
% Grade		0		0						0		
Ideal Sat	2100	1900		1900	1900					1900		1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T		T	R					L	T	R
Lane Width	11.0	12.0		12.0	12.0					10.0		10.0
RTOR Vol					0							0
Adj Flow	904	504		550	1186					262		234
%InSharedLn												
Prop LTS	1.000	0.000		0.000								
Prop RTS		0.000		0.000	1.000							1.000
Peds Bikes				0			0			0		
Buses	0	0		0	0					0		0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0					0.0		0.0
Arriv. Type	3	3		3	3					3		3
Unit Ext.	3.0	3.0		3.0	3.0					3.0		3.0
I Factor		0.508		0.176							1.000	
Lost Time	2.0	2.0		2.0	2.0					2.0		2.0
Ext of g	3.0	2.0		2.0	2.0					2.0		2.0
Ped Min g				24.6			3.2			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left Thru Right Peds	P P	P P			NB	Left Thru Right Peds		
WB	Left Thru Right Peds			P P		SB	Left Thru Right Peds	P P	
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		38.0	24.0				13.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	877	484			517	1150							241		215
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	904	504			550	1186							262		234
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T	R		L	T	R
Adj flow	904	504			550	1186			262				262		234
Prop LTs	1.000	0.000			0.000										
Prop RTs	0.000				0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T	R		L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0	2	0	1			
fW	0.967	1.000			1.000	1.000				0.933		0.933			
fHV	0.990	0.990			0.990	0.990				0.990		0.990			
fG	1.000	1.000			1.000*1.000*					1.000		1.000			
fP	1.000	0.875			1.000	1.000				1.000		1.000			
fBB	1.000	1.000			1.000	1.000				1.000		1.000			
fA	1.000	1.000			1.000	1.000				1.000		1.000			
fLU	1.000	1.000			1.000	1.000				0.971		1.000			
fRT		1.000			1.000	0.850						0.850			
fLT	0.950	1.000			1.000					0.950					
Sec.	0.138														
fLpb	1.000	1.000			1.000					1.000					
fRpb		1.000			1.000	1.000								1.000	
S	1909	1646			1881	1599				3239				1492	
Sec.	277														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	--Group-- v/c Ratio
Eastbound							
Prot	L	827	1909	# 0.43	0.433	827	1.00
Perm		77	277	0.28	0.322	89	0.87
Left		904			0.76	916	0.99
Prot	T	504	1646	0.31	0.74	1225	0.41
Perm							
Thru							
Right							
Westbound							
Prot	T	550	1881	# 0.29	0.27	502	1.10
Perm							
Left							
Prot	R	1186	1599	0.74	1.00	1599	0.74
Perm							
Thru							
Right							
Northbound							
Prot	L	262	3239	# 0.08	0.14	468	0.56
Perm							
Left							
Prot	R	234	1492	0.16	0.62	928	0.25
Perm							
Thru							
Right							
Southbound							
Prot	L	262	3239	# 0.08	0.14	468	0.56
Perm							
Left							
Prot	R	234	1492	0.16	0.62	928	0.25
Perm							
Thru							
Right							

Control Delay and LOS Determination.

[illegible]

R 0.25 0.62 7.6 1.000 928 0.50 0.7 0.0 8.3 A

Intersection delay = 26.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)	67.0			
Effective permitted green time for LT lane group, g(s)	29.0			
Opposing effective green time, go (s)	24.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	904			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	550			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	22.60			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.75			
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73			
gq, (see Exhibit C16-4,5,6,7,8)	29.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.00			
n=Max(gq-gf)/2,0)	14.50			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.18			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.138			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

 For special case of single-lane approach opposed by multilane approach,
 see text.
 * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
 left-turn lane and redo calculations.
 ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach
 or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

EB WB NB SB

Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Pedestrian flow rate, Vpedg (p/h)
 OCCpedg
 Opposing queue clearing green, gq (s)
 Eff. ped. green consumed by opp. veh. queue, gq/gp
 OCCpedu
 Opposing flow rate, Vo (veh/h)
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion of left turns, PLT
 Proportion of left turns using protected phase, PLTA
 Left-turn adjustment, fLpb
 Permitted Right Turns
 Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Conflicting bicycle volume, Vbic (bicycles/h)
 Vpedg
 OCCpedg
 Effective green, g (s)
 Vbicg

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	904			
v/c ratio from Capacity Worksheet, X	0.99			
Protected phase effective green interval, g (s)	39.0			
Opposing queue effective green interval, gq	25.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	22.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.25			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.56			
XPerm	3.26			
XProt	0.74			
Case	3			
Queue at beginning of green arrow, Qa	10.58			
Queue at beginning of unsaturated green, Qu	6.28			
Residual queue, Qr	5.05			
Uniform Delay, d1	20.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		20.9	0.00	0.0	0.0	39.3
T	0.0	0.00	11.5	4.2	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	33.0	33.0	0.00	12.0	0.0	82.3
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.6
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	38.5	35.8	0.00	0.0	0.0	40.6
	0.0						0.0	
R	0.0	0.00	17.0	7.6	0.00	0.0	0.0	8.3
Intersection Delay			26.5	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound	
LaneGroup	L	T		T	R				L	R
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0
Flow Rate	904	504		550	1186				134	234
So	2100	1900		1900	1900				1900	1900
No.Lanes	1	1	0	1	1	0	0	0	2	0
SL	1213	1646		1881	1599				1668	1492
LnCapacity	916	1225		502	1599				240	928
Flow Ratio	0.7	0.3		0.3	0.7				0.1	0.2
v/c Ratio	0.99	0.41		1.10	0.74				0.56	0.25
Grn Ratio	0.76	0.74		0.27	1.00				0.14	0.62
I Factor		0.508		0.176					1.000	
AT or PVG	3	3		3	3				3	3
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00
PF2	1.00	1.00		1.00					1.00	1.00
Q1	9.7	4.6		13.8					3.1	2.6
kB	0.5	0.7		0.1	0.3				0.4	1.1
Q2	7.1	0.5		7.2	0.8				0.5	0.4
Q Average	16.8	5.1		20.9					3.6	3.0
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0
Q Storage	0	0		0	0				0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2					1.2	1.3
BOQ	20.2	6.3		25.2					4.5	3.7
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4					1.5	1.6
BOQ	23.7	7.7		29.4					5.6	4.7
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5					1.7	1.8
BOQ	25.5	8.6		31.6					6.3	5.3
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.6					2.1	2.2
BOQ	27.5	10.0		33.8					7.6	6.4
QSRatio										
98th Percentile Output:										
fB%	1.8	2.2		1.7					2.4	2.5
BOQ	29.4	11.4		36.1					8.8	7.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/10/13	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 Miti-Action Conditions
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0				35.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	841	2025	0.84	0.50	31.1	C		
TR	1066	2132	0.05	0.50	11.6	B	29.9	C

LTR	1089	3266	0.09	0.33	20.8	C	20.8	C
-----	------	------	------	------	------	---	------	---

LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	544	1399	0.17	0.39	18.5	B	202.7	F
R	924	1599	1.42	0.58	215.3	F		

Intersection Delay = 136.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	178	12	0	0	13	16	0	0	1	23	0	436
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	710	48			99			1			90	1316
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000
Peds Bikes	0		0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase	0.0		0.0									0.0
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.967			1.000			1.000			0.855	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right			P			WB	Right		
Green		30.0		12.0					35.0	
Yellow		3.0		3.0					3.0	
All Red		0.0		2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	682	46	0	0	46	58	0	0	1	84	0	1622
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	710	48	0	0	51	48	0	0	1	90	0	1316
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	710	48			99			1			90	1316
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.990	0.990
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.927			0.850		1.000	0.850
fLT	0.950	1.000			1.000			1.000		0.744	
Sec.	0.690										
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	2025	2132			3266			3045		1399	1599
Sec.	1471										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	252	2025	0.12	0.189	383	0.66
Perm		458	1471	# 0.31	0.311	458	1.00
Left		710			0.50	841	0.84
Prot	TR	48	2132	0.02	0.50	1066	0.05
Perm							
Thru							
Right	LTR	99	3266	0.03	0.33	1089	0.09
Prot							
Perm							
Left	LTR	1	3045	0.00	0.39	1184	0.00
Prot							
Perm							
Thru	LT	90	1399	0.06	0.39	544	0.17
Right							
Prot	R	1316	1599	# 0.82	0.58	924	1.42
Perm							
Left							
Prot	LT	90	1399	0.06	0.39	544	0.17
Perm							
Thru							
Right	R	1316	1599	# 0.82	0.58	924	1.42

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.13
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.84	0.50	21.3	1.000	841	0.50	9.8	0.0	31.1	C			
TR	0.05	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	29.9	C	
Westbound													
LTR	0.09	0.33	20.6	1.000	1089	0.50	0.2	0.0	20.8	C	20.8	C	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.17	0.39	18.0	1.000	544	0.50	0.6	0.0	18.5	B	202.7	F	

R 1.42 0.58 19.0 1.000 924 0.50 196.3 0.0 215.3 F

Intersection delay = 136.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	28.0			
Opposing effective green time, go (s)	30.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	710			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	99			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	17.75			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.30			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.45			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.690			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		30.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		30.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	90
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	48	90	1
Lost time for LT lane group, tL	3.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.25
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.60	2.25	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	30.00	35.00	32.77
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.744

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	99	48	90	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	28.0	30.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.485	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	710			
v/c ratio from Capacity Worksheet, X	0.84			
Protected phase effective green interval, g (s)	17.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	28.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.563			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.41			
XPerm	1.26			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	2.96			
Queue at beginning of unsaturated green, Qu	8.88			
Residual queue, Qr	0.00			
Uniform Delay, d1	21.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00		21.3	0.00	0.0	0.0	31.1
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	30.0	20.6	0.00	0.0	0.0	20.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	18.0	0.00	0.0	0.0	18.5
R	0.0	0.00	19.0	19.0	0.00	98.0	0.0	215.3
Intersection Delay			136.8	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	710	48			51				0				90	1316	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1680	2132			1715				1599				1399	1599	
LnCapacity	841	1066			571				621				544	924	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.8	
v/c Ratio	0.84	0.05			0.09				0.00				0.17	1.42	
Grn Ratio	0.50	0.50			0.33				0.39				0.39	0.58	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	10.6	0.6			0.9				0.0				1.5	32.9	
kB	1.0	1.2			0.8				0.8				0.6	0.9	
Q2	4.2	0.1			0.1				0.0				0.1	51.9	
Q Average	14.8	0.7			1.0				0.0				1.6	84.8	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	17.8	0.9			1.2				0.0				2.0	102	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.6				1.7				1.6	1.4	
BOQ	20.9	1.1			1.6				0.0				2.6	119	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	22.5	1.3			1.8				0.0				3.0	127	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.4				2.6				2.3	1.6	
BOQ	24.4	1.7			2.3				0.0				3.7	136	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			2.9				3.2				2.8	1.7	
BOQ	26.3	2.0			2.8				0.0				4.5	144	
QSRatio															

ERROR MESSAGES

No errors to report.

Analyst: ML Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 08/28/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L T			L			LTR		
Volume	65	0		725	89		5			28	959	45
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P	P			SB Left	P		
Thru	P	P			Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0	6.0				15.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	752	1881	0.12	0.40	11.6	B	11.6	B
----	-----	------	------	------	------	---	------	---

Westbound

L	874	1829	0.91	0.58	27.4	C		
T	1123	1925	0.09	0.58	5.6	A	25.0	C

Northbound

L	120	473	0.05	0.25	17.8	B	17.8	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	1217	4866	0.95	0.25	38.9	D	38.9	D
-----	------	------	------	------	------	---	------	---

Intersection Delay = 31.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/28/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	65	0		725	89		5			28	959	45
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	22	0		199	24		2			8	269	13
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR			L	T		L			LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	87			797	98		6			1160		
%InSharedLn												
Prop LTs		0.000		1.000	0.000		1.000				0.027	
Prop RTs	0.000			0.000						0.044		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase				0.0								
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1		11.8		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P	P			SB	Left	P	
	Thru	P	P				Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		24.0	6.0					15.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	65	0		725	89		5			28	959	45
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	87	0		797	98		6			31	1078	51
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L T			L			LTR		
Adj flow	87			797	98		6			1160		
Prop LTs	0.000			1.000 0.000			1.000			0.027		
Prop RTs	0.000			0.000						0.044		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.993	
fLT	1.000		0.950 1.000		0.267		0.999	
Sec.			0.701					
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1829 1925		473		4866	
Sec.			1348					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	87	1881	0.05	0.40	752	0.12
Right							
Westbound							
Prot		258	1829	# 0.14	0.183	335	0.77
Perm		539	1348	# 0.40	0.400	539	1.00
Left	L	797			0.58	874	0.91
Prot							
Perm							
Thru	T	98	1925	0.05	0.58	1123	0.09
Right							
Northbound							
Prot							
Perm							
Left	L	6	473	0.01	0.25	120	0.05
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1160	4866	# 0.24	0.25	1217	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.12	0.40	11.3	1.000	752	0.50	0.3	0.0	11.6	B	11.6	B	
Westbound													
L	0.91	0.58	12.3	1.000	874	0.50	15.0	0.0	27.4	C			
T	0.09	0.58	5.5	1.000	1123	0.50	0.1	0.0	5.6	A	25.0	C	
Northbound													
L	0.05	0.25	17.1	1.000	120	0.50	0.7	0.0	17.8	B	17.8	B	
Southbound													
LTR	0.95	0.25	22.2	1.000	1217	0.50	16.8	0.0	38.9	D	38.9	D	

Intersection delay = 31.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)		35.0	15.0	
Effective permitted green time for LT lane group, g(s)		24.0	15.0	
Opposing effective green time, go (s)		24.0	15.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		797	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		87	1160	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		13.28	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.45	7.10	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.60	0.75	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	11.22	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		24.00	3.78	
n=Max(gq-gf)/2,0)		0.00	5.61	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.43	4.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)			5.27	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.17	0.27	
gdifff=max(gq-gf,0)		0.00	11.22	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.70	0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.701	0.267	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C		60.0	sec	
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.027
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 0.908
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	797			
v/c ratio from Capacity Worksheet, X	0.91			
Protected phase effective green interval, g (s)	11.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	24.00			
Red time r=(C-g-gq-gu)	25.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.508			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.37			
XPerm	1.21			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	1.86			
Queue at beginning of unsaturated green, Qu	5.53			
Residual queue, Qr	0.00			
Uniform Delay, d1	12.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
TR	0.0 0.0 0.0	0.00	18.0	11.3	0.00	0.0	0.0 0.0 0.0	11.6
Westbound								
L	0.0	0.00		12.3	0.00	0.0	0.0	27.4
T	0.0 0.0	0.00	12.5	5.5	0.00	0.0	0.0 0.0	5.6
Northbound								
L	0.0 0.0 0.0	0.00	22.5	17.1	0.00	0.0	0.0 0.0 0.0	17.8
Southbound								
LTR	0.0 0.0	0.00	22.5	22.2	0.00	0.0	0.0 0.0	38.9

Intersection Delay 31.9 sec/veh Intersection LOS C

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	T	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	87		797	98	6		425	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1499	1925	473		1786	
LnCapacity	752		874	1123	120		446	
Flow Ratio	0.0		0.5	0.1	0.0		0.2	
v/c Ratio	0.12		0.91	0.09	0.05		0.95	
Grn Ratio	0.40		0.58	0.58	0.25		0.25	
I Factor	1.000			0.971		0.951	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.9		6.6	0.7	0.1		7.0	
kB	0.7		0.8	0.9	0.2		0.5	
Q2	0.1		5.1	0.1	0.0		4.0	
Q Average	1.0		11.8	0.8	0.1		10.9	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	1.3		14.2	1.0	0.1		13.2	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.4	1.7	1.7		1.4	
BOQ	1.7		16.8	1.3	0.1		15.7	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.5	1.9	2.0		1.6	
BOQ	1.9		18.2	1.5	0.2		17.0	
QSRatio								
95th Percentile Output:								
fB%	2.4		1.7	2.5	2.6		1.7	
BOQ	2.4		20.0	2.0	0.2		18.7	
QSRatio								
98th Percentile Output:								
fB%	2.9		1.8	3.0	3.2		1.9	
BOQ	2.9		21.7	2.4	0.3		20.4	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 7/8/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	217	390	213	0	87	15	726	65	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		26.0					24.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	700	1616	1.16	0.43	102.6	F	85.0	F
R	693	1599	0.28	0.43	12.0	B		

Westbound

LTR	694	1602	0.18	0.43	11.0	B	11.0	B
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Northbound

LTR	1875	4688	0.46	0.40	14.0	B	14.0	B
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Southbound

Intersection Delay = 49.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/8/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	217	390	213	0	87	15	726	65	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	72	130	71	0	26	5	195	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		809	196		123			854				
%InSharedLn												
Prop LTs		0.357			0.000			0.915				
Prop RTs		0.000	1.000		0.146			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		26.0						24.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	217	390	213	0	87	15	726	65	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	289	520	196	0	105	18	781	70	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT		R	LTR			LTR					
Adj flow	809		196	123			854					
Prop LTs	0.357			0.000			0.915					
Prop RTs	0.000		1.000	0.146			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		1.000			0.980				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.980			0.999				
fLT	0.831			1.000			0.956				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1616	1599		1602			4688				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.16	0.43	17.0	1.000	700	0.50	85.6	0.0	102.6	F	85.0	F
R	0.28	0.43	11.0	1.000	693	0.50	1.0	0.0	12.0	B		
Westbound												
LTR	0.18	0.43	10.4	1.000	694	0.50	0.6	0.0	11.0	B	11.0	B
Northbound												
LTR	0.46	0.40	13.2	1.000	1875	0.50	0.8	0.0	14.0	B	14.0	B
Southbound												

Intersection delay = 49.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	26.0	26.0		
Effective permitted green time for LT lane group, g(s)	26.0	26.0		
Opposing effective green time, go (s)	26.0	26.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	289	0	
Proportion of LT in LT lane group, PLT	0.357	0.000	0.915
Proportion of LT in opposing flow, PLTo	0.00	0.36	
Adjusted opposing flow rate, Vo (veh/h)	123	809	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.82	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.05	13.48	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57	0.57	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.64	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.00	11.36	
n=Max(gq-gf)/2,0)	0.00	7.32	
PTHo=1-PLTo	1.00	0.64	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.36	0.00	
EL1 (refer to Exhibit C16-3)	1.57	3.11	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.69	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.08	
gdifff=max(gq-gf,0)	0.00	14.64	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.44	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.831	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	26.0	26.0	24.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	14.64		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.563		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	123	809	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.357	0.000	0.915	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	26.0	26.0	24.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	26.0	26.0	24.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.146	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	17.0	17.0	0.00	27.2	0.0	102.6
R	0.0	0.00	17.0	11.0	0.00	0.0	0.0	12.0
Westbound								
	0.0						0.0	
LTR	0.0	0.00	17.0	10.4	0.00	0.0	0.0	11.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.0	13.2	0.00	0.0	0.0	14.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			49.8	sec/veh	Intersection LOS		D	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	809	196	123	313			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1616	1599	1602	1720			
LnCapacity	700	693	694	688			
Flow Ratio	0.5	0.1	0.1	0.2			
v/c Ratio	1.16	0.28	0.18	0.45			
Grn Ratio	0.43	0.43	0.43	0.40			
I Factor	0.997		0.993	0.967			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	13.5	2.1	1.3	3.8			
kB	0.7	0.7	0.7	0.6			
Q2	17.5	0.3	0.1	0.5			
Q Average	31.0	2.4	1.4	4.4			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.2			
BOQ	37.2	3.0	1.8	5.4			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.5			
BOQ	43.4	3.8	2.3	6.6			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.8	1.9	1.7			
BOQ	46.5	4.3	2.6	7.4			
QSRatio							
95th Percentile Output:							
fB%	1.6	2.2	2.4	2.0			
BOQ	49.6	5.3	3.3	8.8			
QSRatio							
98th Percentile Output:							
fB%	1.7	2.6	2.8	2.3			
BOQ	52.7	6.2	4.0	10.1			
QSRatio							

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		193	301	625	173	152	228		420		17
Lane Width	10.0		13.0		11.0		12.0	12.0		11.5		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	12.0	16.0				17.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	334	1668	0.08	0.20	19.9	B	36.7	D
R	330	1652	0.82	0.20	38.3	D		
Westbound								
LTR	1260	4724	1.00	0.27	40.2	D	40.2	D
Northbound								
L	220	776	0.75	0.28	38.8	D		
T	528	1863	0.47	0.28	20.5	C	27.8	C
Southbound								
TR	992	3501	0.49	0.28	19.2	B	19.2	B

Intersection Delay = 33.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		193	301	625	173	152	228		420	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		68	86	180	50	41	62		117	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			11.5	
RTOR Vol			0			0						0
Adj Flow	27		272		1263		165	248			486	
%InSharedLn												
Prop LTS					0.274		1.000	0.000			0.000	
Prop RTS			1.000		0.158			0.000			0.039	
Peds Bikes	0	0		0	0					0	0	
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		12.0	16.0					17.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		193	301	625	173	152	228		420	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		272	346	718	199	165	248		467	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	2	0
Lane group	L		R			LTR	L		T			TR
Adj flow	27		272			1263	165	248				486
Prop LTs						0.274	1.000	0.000				0.000
Prop RTs			1.000			0.158		0.000				0.039

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	1
fW	0.933	1.033	0.967	0.967	1.000	1.000	0.983	0.983
fHV	0.990	0.990	0.980	0.980	0.980	0.980	0.990	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	0.952	0.952
fRT		0.850	0.976	0.976		1.000	0.994	0.994
fLT	0.950		0.986	0.986	0.417	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4724	4724	776	1863	3501	3501
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.20	334	0.08
Prot							
Perm							
Thru							
Right	R	272	1652	# 0.16	0.20	330	0.82
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1263	4724	# 0.27	0.27	1260	1.00
Right							
Northbound							
Prot							
Perm							
Left	L	165	776	# 0.21	0.28	220	0.75
Prot							
Perm							
Thru	T	248	1863	0.13	0.28	528	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	486	3501	0.14	0.28	992	0.49
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.08	0.20	19.5	1.000	334	0.50	0.3	0.0	19.9	B	36.7	D	
R	0.82	0.20	23.0	1.000	330	0.50	15.4	0.0	38.3	D			
Westbound													
LTR	1.00	0.27	22.0	1.000	1260	0.50	18.2	0.0	40.2	D	40.2	D	
Northbound													
L	0.75	0.28	19.6	1.000	220	0.50	19.2	0.0	38.8	D	27.8	C	
T	0.47	0.28	17.8	1.000	528	0.50	2.7	0.0	20.5	C			
Southbound													
TR	0.49	0.28	17.9	1.000	992	0.50	1.3	0.0	19.2	B	19.2	B	

Intersection delay = 33.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)			17.0	
Effective permitted green time for LT lane group, g(s)			17.0	
Opposing effective green time, go (s)			17.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			165	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			486	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.75	
Opposing lane util. factor, fLUo	0.908		0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.25	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.72	
gq, (see Exhibit C16-4,5,6,7,8)			2.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			14.89	
n=Max(gq-gf)/2,0)			1.05	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.10	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.24	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.42	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.417	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C			60.0	sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.274 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			17.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			2.11	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.124	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			486	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0		17.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	16.0		17.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.158	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	24.0	19.5	0.00	0.0	0.0	19.9
	0.0						0.0	
R	0.0	0.00	24.0	23.0	0.00	0.0	0.0	38.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.0	22.0	0.00	0.8	0.0	40.2
	0.0						0.0	
Northbound								
L	0.0	0.00	21.5	19.6	0.00	0.0	0.0	38.8
T	0.0	0.00	21.5	17.8	0.00	0.0	0.0	20.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	21.5	17.9	0.00	0.0	0.0	19.2
	0.0						0.0	

Intersection Delay	33.5	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	27	272	463	165	248	255
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	2 0
SL	1668	1652	1734	776	1863	1838
LnCapacity	334	330	462	220	528	521
Flow Ratio	0.0	0.2	0.3	0.2	0.1	0.1
v/c Ratio	0.08	0.82	1.00	0.75	0.47	0.49
Grn Ratio	0.20	0.20	0.27	0.28	0.28	0.28
I Factor	0.717		0.483	0.917		0.747
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.4	4.3	7.7	2.5	3.4	3.5
kB	0.3	0.3	0.2	0.3	0.5	0.4
Q2	0.0	1.1	3.8	0.7	0.4	0.4
Q Average	0.4	5.5	11.5	3.2	3.9	3.9
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.2	1.2	1.3	1.2	1.2
BOQ	0.5	6.8	13.9	4.1	4.8	4.9
QSRatio						
85th Percentile Output:						
fB%	1.7	1.5	1.4	1.6	1.5	1.5
BOQ	0.7	8.2	16.5	5.0	5.9	6.0
QSRatio						
90th Percentile Output:						
fB%	2.0	1.7	1.5	1.8	1.7	1.7
BOQ	0.8	9.2	17.9	5.7	6.7	6.8
QSRatio						
95th Percentile Output:						
fB%	2.5	1.9	1.7	2.1	2.1	2.1
BOQ	1.0	10.6	19.6	6.9	8.0	8.1
QSRatio						
98th Percentile Output:						
fB%	3.1	2.2	1.8	2.5	2.4	2.4
BOQ	1.2	12.1	21.3	8.1	9.2	9.4
QSRatio						

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	8	18	293	18	105	13	349	241	86	446	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 615 1419 0.07 0.43 15.1 B 15.1 B

Westbound

L 563 1299 0.58 0.43 23.1 C
 T 788 1818 0.03 0.43 14.7 B 21.1 C
 R 586 1352 0.20 0.43 16.5 B

Northbound

LTR 763 1674 0.86 0.46 28.6 C 28.6 C

Southbound

LTR 631 1385 0.95 0.46 39.8 D 39.8 D

Intersection Delay = 30.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	8	18	293	18	105	13	349	241	86	446	8
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	81	5	29	4	95	65	24	124	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		41		326	20	117		655			601	
%InSharedLn												
Prop LTs		0.244		1.000	0.000			0.021			0.160	
Prop RTs		0.512			0.000	1.000		0.400			0.015	
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		39.0						41.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	8	18	293	18	105	13	349	241	86	446	8
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	10	10	21	326	20	117	14	379	262	96	496	9
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	41			326	20	117	655			601		
Prop LTs	0.244			1.000	0.000		0.021			0.160		
Prop RTs	0.512			0.000 1.000			0.400			0.015		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			L	T	R	LTR			LTR		
So	1900			1900	1900	1900	1900			1900		
Lanes 0	1	0		1	1	1	0	1	0	0	1	0
fW	1.000			1.000	0.967	0.967	0.967			1.000		
fHV	0.980			0.990	0.990	0.990	1.000			0.990		
fG	1.000			1.000	1.000	1.000	1.000			1.000		
fP	0.875			1.000	1.000	0.875	1.000			1.000		
fBB	1.000			1.000	1.000	1.000	1.000			1.000		
fA	1.000			1.000	1.000	1.000	1.000			1.000		
fLU	1.000			1.000	1.000	1.000	1.000			1.000		
fRT	0.931				1.000	0.850	0.946			0.998		
fLT	0.963			0.730	1.000		0.985			0.740		
Sec.												
fLpb	1.000			0.946	1.000		1.000			0.997		
fRpb	0.971				1.000	1.000	0.978			1.000		
S	1419			1299	1818	1352	1674			1385		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1419	0.03	0.43	615	0.07
Right							
Westbound							
Prot							
Perm							
Left	L	326	1299	# 0.25	0.43	563	0.58
Prot							
Perm							
Thru	T	20	1818	0.01	0.43	788	0.03
Right	R	117	1352	0.09	0.43	586	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	655	1674	0.39	0.46	763	0.86
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	601	1385	# 0.43	0.46	631	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.07	0.43	14.9	1.000	615	0.50	0.2	0.0	15.1	B	15.1	B	
Westbound													
L	0.58	0.43	19.3	1.000	563	0.50	3.8	0.0	23.1	C			
T	0.03	0.43	14.6	1.000	788	0.50	0.1	0.0	14.7	B	21.1	C	
R	0.20	0.43	15.8	1.000	586	0.50	0.7	0.0	16.5	B			
Northbound													
LTR	0.86	0.46	21.9	1.000	763	0.50	6.7	0.0	28.6	C	28.6	C	
Southbound													
LTR	0.95	0.46	23.6	1.000	631	0.50	16.2	0.0	39.8	D	39.8	D	

Intersection delay = 30.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		326		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.24		
Adjusted opposing flow rate, Vo (veh/h)		41		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		8.15		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.02		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.76		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho*n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.730		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	14	96
Proportion of LT in LT lane group, PLT	0.244	0.000	0.021
Proportion of LT in opposing flow, PLTo	0.00	0.16	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	601	655
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.35	2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	15.02	16.38
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.1	21.3	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57	0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.44	16.83
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.86	19.71	24.17
n=Max(gq-gf)/2,0)	0.00	0.00	6.30
PTHo=1-PLTo	1.00	0.84	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.24	0.02	0.16
EL1 (refer to Exhibit C16-3)	1.40	2.54	2.68
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.96
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	12.60
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96	0.98	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.963	0.985	0.740

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	15.44	16.83
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.377	0.410
OCCpedu	0.000	0.058	0.000	0.043
Opposing flow rate, Vo (veh/h)	20	41	601	655
OCCr	0.000	0.054	0.000	0.017
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.946	1.000	0.983
Proportion of left turns, PLT	0.244	1.000	0.021	0.160
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.946	1.000	0.997
Permitted Right Turns				
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.512	1.000	0.400	0.015
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.978	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.5	14.9	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
L	0.0	0.00	25.5	19.3	0.00	0.0	0.0	23.1
T	0.0	0.00	25.5	14.6	0.00	0.0	0.0	14.7
R	0.0	0.00	25.5	15.8	0.00	0.0	0.0	16.5
Northbound								
	0.0						0.0	
LTR	0.0	0.00	24.5	21.9	0.00	0.0	0.0	28.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	24.5	23.6	0.00	0.0	0.0	39.8
	0.0						0.0	
Intersection Delay			30.1	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup		LTR	L	T	R		LTR		LTR
Init Queue		0.0	0.0	0.0	0.0		0.0		0.0
Flow Rate		41	326	20	117		655		601
So		1900	1900	1900	1900		1900		1900
No.Lanes	0	1	0	1	1	0	1	0	0
SL		1419	1299	1818	1352		1674		1385
LnCapacity		615	563	788	586		763		631
Flow Ratio		0.0	0.3	0.0	0.1		0.4		0.4
v/c Ratio		0.07	0.58	0.03	0.20		0.86		0.95
Grn Ratio		0.43	0.43	0.43	0.43		0.46		0.46
I Factor		1.000		0.887			0.516		0.500
AT or PVG		3	3	3	3		3		3
Pltn Ratio		1.00	1.00	1.00	1.00		1.00		1.00
PF2		1.00	1.00	1.00	1.00		1.00		1.00
Q1		0.6	6.2	0.3	1.8		14.6		14.5
kB		0.8	0.7	0.9	0.7		0.5		0.4
Q2		0.1	0.9	0.0	0.2		2.5		4.0
Q Average		0.7	7.1	0.3	2.0		17.1		18.5
Q Spacing		25.0	25.0	25.0	25.0		25.0		25.0
Q Storage		0	0	0	0		0		0
Q S Ratio									
70th Percentile Output:									
fB%		1.3	1.2	1.3	1.3		1.2		1.2
BOQ		0.8	8.7	0.4	2.5		20.6		22.2
QSRatio									
85th Percentile Output:									
fB%		1.7	1.5	1.7	1.6		1.4		1.4
BOQ		1.1	10.4	0.5	3.2		24.2		26.0
QSRatio									
90th Percentile Output:									
fB%		1.9	1.6	2.0	1.8		1.5		1.5
BOQ		1.3	11.5	0.6	3.6		26.0		27.9
QSRatio									
95th Percentile Output:									
fB%		2.5	1.8	2.5	2.3		1.6		1.6
BOQ		1.6	13.0	0.8	4.5		28.0		30.0
QSRatio									
98th Percentile Output:									
fB%		3.0	2.1	3.1	2.7		1.7		1.7
BOQ		2.0	14.6	1.0	5.4		30.0		32.1
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Arthur Kill Rd & Bloomingdl Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/10/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	238	239		312	246		151		255			
Lane Width	16.0			10.0	10.0			11.0				
RTOR Vol		56						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P	P			SB Left			
	Thru	P	P			Thru			
	Right					Right			
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		29.0	13.0				35.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR 635 1971 0.85 0.32 41.1 D 41.1 D

Westbound

L 404 1620 0.87 0.50 53.6 D
 T 853 1705 0.32 0.50 14.4 B 36.4 D

Northbound

LR 556 1430 0.86 0.39 40.5 D 40.5 D

Southbound

Intersection Delay = 39.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/10/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		238	239	312	246		151		255			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		76	77	88	69		44		75			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		10.0	10.0			11.0				
RTOR Vol			56						0			
Adj Flow		540		351	276			478				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.372				
Prop RTs		0.435			0.000			0.628				
Peds Bikes		0						0		0		
Buses		2		0	0			0				
%InProtPhase				0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P	P			SB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		29.0	13.0				35.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		238	239	312	246		151		255			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		305	235	351	276		178		300			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		540		351	276		478					
Prop LTs		0.000		1.000	0.000		0.372					
Prop RTs		0.435		0.000			0.628					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.933 0.933		0.967			
fHV	0.980		0.962 0.962		0.990			
fG	1.000		1.000 1.000		1.000			
fP	1.000		1.000 1.000		0.875			
fBB	0.992		1.000 1.000		1.000			
fA	1.000		1.000 1.000		1.000			
fLU	1.000		1.000 1.000		1.000			
fRT	0.941		1.000		0.915			
fLT	1.000		0.950 1.000		0.982			
Sec.			0.148					
fLpb	1.000		1.000 1.000		1.000			
fRpb	1.000		1.000		1.000			
S	1971		1620 1705		1430			
Sec.			253					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.85	0.32	28.5	1.000	635	0.50	12.6	0.0	41.1	D	41.1	D
Westbound												
L	0.87	0.50	32.2	1.000	404	0.50	21.5	0.0	53.6	D		
T	0.32	0.50	13.4	1.000	853	0.50	1.0	0.0	14.4	B	36.4	D
Northbound												
LR	0.86	0.39	25.2	1.000	556	0.50	15.2	0.0	40.5	D	40.5	D
Southbound												

Intersection delay = 39.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		27.0		
Opposing effective green time, go (s)		29.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		351		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		540		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		8.78		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.50		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.68		
gq, (see Exhibit C16-4,5,6,7,8)		18.77		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		8.23		
n=Max(gq-gf)/2,0)		9.39		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.16		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.15		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.148		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.372
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

-----SUPPLEMENTAL UNIFORM DELAY WORKSHEET-----

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v		351		
v/c ratio from Capacity Worksheet, X		0.87		
Protected phase effective green interval, g (s)		18.0		
Opposing queue effective green interval, gq		18.77		
Unopposed green interval, gu		8.23		
Red time $r=(C-g-gq-gu)$		45.0		
Arrival rate, $qa=v/(3600(\max[X,1.0]))$		0.10		
Protected ph. departure rate, $Sp=s/3600$		0.450		
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$		0.23		
XPerm		3.70		
XProt				
Case		5		
Queue at beginning of green arrow, Qa		5.12		
Queue at beginning of unsaturated green, Qu		6.22		
Residual queue, Qr		0.00		
Uniform Delay, d1		32.2		

-----DELAY/LOS WORKSHEET WITH INITIAL QUEUE-----

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	30.5	28.5	0.00	0.0	0.0	41.1
	0.0						0.0	
Westbound								
L	0.0	0.00		32.2	0.00	0.0	0.0	53.6
T	0.0	0.00	22.5	13.4	0.00	0.0	0.0	14.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.2	0.00	0.0	0.0	40.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	

Intersection Delay 39.1 sec/veh Intersection LOS D

-----BACK OF QUEUE WORKSHEET-----

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	TR			L	T	LR					
Init Queue	0.0			0.0	0.0	0.0					
Flow Rate	540			351	276	478					
So	1900			1900	1900	1900					
No.Lanes	0	1	0	1	1	0	0	0	0	0	0
SL	1971			800	1705	1430					
LnCapacity	635			404	853	556					
Flow Ratio	0.3			0.4	0.2	0.3					
v/c Ratio	0.85			0.87	0.32	0.86					
Grn Ratio	0.32			0.50	0.50	0.39					
I Factor	0.927			0.992		0.953					
AT or PVG	3			3	3	3					
Pltn Ratio	1.00			1.00	1.00	1.00					
PF2	1.00			1.00	1.00	1.00					
Q1	12.6			5.3	4.1	11.0					
kB	0.8			0.6	1.0	0.7					
Q2	3.4			2.8	0.5	3.3					
Q Average	16.0			8.1	4.6	14.3					
Q Spacing	25.0			25.0	25.0	25.0					
Q Storage	0			0	0	0					
Q S Ratio											
70th Percentile Output:											
fB%	1.2			1.2	1.2	1.2					
BOQ	19.3			9.9	5.7	17.2					
QSRatio											
85th Percentile Output:											
fB%	1.4			1.5	1.5	1.4					
BOQ	22.6			11.8	7.0	20.2					
QSRatio											
90th Percentile Output:											
fB%	1.5			1.6	1.7	1.5					
BOQ	24.3			12.9	7.8	21.8					
QSRatio											
95th Percentile Output:											
fB%	1.6			1.8	2.0	1.7					
BOQ	26.3			14.6	9.2	23.7					
QSRatio											
98th Percentile Output:											
fB%	1.8			2.0	2.3	1.8					
BOQ	28.2			16.2	10.6	25.5					
QSRatio											

ERROR MESSAGES

No errors to report.

Accident Data

Charleston Development (SI)

Data Source: NYSDMV/NYSDOT

Allentown Lane-Veterans Road West/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000449	2008	1	1	0	0	1	1
0000449	2009	3	1	0	0	1	1
0000449	2010	4	3	0	0	3	3
Total		8	5	0	0	5	5

North Bridge Street/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000447	2008	1	1	0	0	1	1
0000447	2009	0	0	0	0	0	0
0000447	2010	0	0	0	0	0	0
Total		1	1	0	0	1	1

Richmond Valley Road/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000291	2008	2	0	0	0	0	0
0000291	2009	0	0	0	0	0	0
0000291	2010	1	0	0	0	0	0
Total		3	0	0	0	0	0

Richmond Valley Road/Page Avenue

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000372	2008	0	0	0	0	0	0
0000372	2009	2	1	0	0	1	1
0000372	2010	0	0	0	0	0	0
Total		2	1	0	0	1	1

South Bridge Street/Page Avenue-Boscombe Avenue

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000492	2008	2	1	1	0	0	1
0000492	2009	0	0	0	0	0	0
0000492	2010	2	2	0	0	2	2
Total		4	3	1	0	2	3

Veterans Road West/Mohr Street-Korean War Veterans Parkway ramps

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000465	2008	0	0	0	0	0	0
0000465	2009	0	0	0	0	0	0
0000465	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Veterans Road West/Tyrellan Avenue

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000872	2008	2	1	0	0	1	1
0000872	2009	2	2	0	0	2	2
0000872	2010	1	1	0	0	2	2
Total		5	4	0	0	5	5

Note: There is one fatal crash in 2011 (7/23/2011, motor vehicle occupant, NYPD fatality data).

Boscombe Avenue/Outerbridge crossing on- & off-ramps

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000497	2008	0	0	0	0	0	0
0000497	2009	0	0	0	0	0	0
0000497	2010	0	0	0	0	0	0

Total	0	0	0	0	0	0
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Boscombe Avenue/Tyrellan Avenue

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000863	2008	0	0	0	0	0	0
0000863	2009	0	0	0	0	0	0
0000863	2010	1	0	0	0	0	0
Total		1	0	0	0	0	0

Bricktown Centre Road-Mohr Street/Veterans Road West

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
No node ID/No crash records							
Total							

Englewood Avenue/Veterans Road West

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000906	2008	0	0	0	0	0	0
0000906	2009	0	0	0	0	0	0
0000906	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Englewood Avenue/Veterans Road East

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000950	2008	1	1	0	0	1	1
0000950	2009	1	0	0	0	0	0
0000950	2010	0	0	0	0	0	0
Total		2	1	0	0	1	1

Englewood Avenue/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001048	2008	0	0	0	0	0	0
0001048	2009	0	0	0	0	0	0
0001048	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Sharrotts Road/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001079	2008	1	0	0	0	0	0
0001079	2009	2	1	1	0	0	1
0001079	2010	0	0	0	0	0	0
Total		3	1	1	0	0	1

Veterans Road East-Drumgoole Road West/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001039	2008	1	0	0	0	0	0
0001039	2009	0	0	0	0	0	0
0001039	2010	0	0	0	0	0	0
Total		1	0	0	0	0	0

South Service Road-Drumgoole Road East/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001146	2008	0	0	0	0	0	0
0001146	2009	1	0	0	0	0	0
0001146	2010	0	0	0	0	0	0
Total		1	0	0	0	0	0

Pleasant Plains Avenue-Amboy Road/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001136	2008	1	1	0	0	1	1
0001136	2009	1	0	0	0	0	0
0001136	2010	3	0	0	0	0	0
Total		5	1	0	0	1	1

Arthur Kill Road/Bloomingdale Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0001011	2008	1	0	0	0	0	0
0001011	2009	2	0	0	0	0	0
0001011	2010	0	0	0	0	0	0
Total		3	0	0	0	0	0

Sharrotts Road/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000481	2008	1	1	0	0	1	1
0000481	2009	2	1	0	0	1	1
0000481	2010	1	1	0	0	1	1
Total		4	3	0	0	3	3

Englewood Avenue/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000469	2008	0	0	0	0	0	0
0000469	2009	0	0	0	0	0	0
0000469	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

South Bridge Street/Arthur Kill Road

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000445	2008	0	0	0	0	0	0
0000445	2009	0	0	0	0	0	0
0000445	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Mohr Street/Tyrellan Avenue

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
No node ID/No crash records							
Total							

Sharrotts Road/Veterans Road West

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000910	2008	0	0	0	0	0	0
0000910	2009	0	0	0	0	0	0
0000910	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Sharrotts Road/Veterans Road East

NODE_ID	YEAR	# of Crashes	# of Injury Crashes	# of Injuries			Total
				Pedestrian	Bike	Motor Vehicle Occupant	
0000967	2008	0	0	0	0	0	0
0000967	2009	0	0	0	0	0	0
0000967	2010	0	0	0	0	0	0
Total		0	0	0	0	0	0

Alternative 2

With-Action

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	9	8	8	118	10	28	27	186	149	29	257	39
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 179 1533 0.17 0.12 26.0 C 26.0 C

Westbound

LTR 482 1929 0.34 0.25 20.4 C 20.4 C

Northbound

LTR 608 1585 0.72 0.38 22.9 C 22.9 C

Southbound

LTR 665 1735 0.59 0.38 18.5 B 18.5 B

Intersection Delay = 20.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	8	8	118	10	28	27	186	149	29	257	39
% Heavy Veh	32	32	32	5	5	5	20	20	20	13	13	13
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
PK 15 Vol	3	3	3	31	3	7	8	56	45	9	77	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		31			164			437			392	
%InSharedLn												
Prop LTs		0.355			0.756			0.076			0.089	
Prop RTs		0.323			0.177			0.412			0.120	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			4			4	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	9	8	8	118	10	28	27	186	149	29	257	39
PHF	0.79	0.79	0.79	0.95	0.95	0.95	0.83	0.83	0.83	0.83	0.83	0.83
Adj flow	11	10	10	124	11	29	33	224	180	35	310	47
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	31			164			437			392		
Prop LTs	0.355			0.756			0.076			0.089		
Prop RTs	0.323			0.177			0.412			0.120		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.758			0.952			0.833			0.885		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.984			0.984		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.956			0.976			0.944			0.984		
fLT	0.983			0.964			0.951			0.941		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1533			1929			1585			1735		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	31	1533	# 0.02	0.12	179	0.17
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	164	1929	# 0.09	0.25	482	0.34
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	437	1585	# 0.28	0.38	608	0.72
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	392	1735	0.23	0.38	665	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.17	0.12	23.9	1.000	179	0.50	2.1	0.0	26.0	C	26.0	C	
Westbound													
LTR	0.34	0.25	18.4	1.000	482	0.50	1.9	0.0	20.4	C	20.4	C	
Northbound													
LTR	0.72	0.38	15.7	1.000	608	0.50	7.2	0.0	22.9	C	22.9	C	
Southbound													
LTR	0.59	0.38	14.7	1.000	665	0.50	3.8	0.0	18.5	B	18.5	B	

Intersection delay = 20.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	35
Proportion of LT in LT lane group, PLT	0.355	0.756	0.076	0.089
Proportion of LT in opposing flow, PLTo			0.09	0.08
Adjusted opposing flow rate, Vo (veh/h)			392	437
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.53	7.28
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			7.37	8.44
gu=g-gq if gq>=gf, or = g-gf if gq<gf			15.26	14.56
n=Max(gq-gf)/2,0)			0.00	0.49
PTHo=1-PLTo			0.91	0.92
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.08	0.09
EL1 (refer to Exhibit C16-3)			2.06	2.16
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.09
gdifff=max(gq-gf,0)			0.00	0.97
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.95	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.951	0.941

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.44
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.367
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				437
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.089
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.323	0.412
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	23.9	0.00	0.0	0.0	26.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.4	0.00	0.0	0.0	20.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	15.7	0.00	0.0	0.0	22.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.7	0.00	0.0	0.0	18.5
	0.0						0.0	
Intersection Delay			20.9	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	31		164		437		392	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0	0 1 0	0	0 1 0	0	0 1 0	
SL	1533		1929		1585		1735	
LnCapacity	179		482		608		665	
Flow Ratio	0.0		0.1		0.3		0.2	
v/c Ratio	0.17		0.34		0.72		0.59	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	0.5		2.2		6.2		5.2	
kB	0.3		0.5		0.6		0.6	
Q2	0.1		0.3		1.5		0.9	
Q Average	0.5		2.5		7.7		6.1	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	0.7		3.2		9.3		7.5	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.6		1.5		1.5	
BOQ	0.9		4.0		11.2		9.1	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.8		1.6		1.6	
BOQ	1.0		4.5		12.3		10.1	
QSRatio								
95th Percentile Output:								
fB%	2.5		2.2		1.8		1.9	
BOQ	1.3		5.5		13.9		11.6	
QSRatio								
98th Percentile Output:								
fB%	3.1		2.6		2.0		2.1	
BOQ	1.6		6.5		15.5		13.1	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			216	178		158	224	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			260	214		190	269	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		147		146				
Peak Hour Factor, PHF		0.75		0.70				
Hourly Flow Rate, HFR		196		208				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		190		404				
C(m) (vph)		1043		336				
v/c		0.18		1.20				
95% queue length		0.66		17.27				
Control Delay		9.2		150.0				
LOS		A		F				
Approach Delay				150.0				
Approach LOS				F				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		216	178	158	224	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		65	54	48	67	
Hourly Flow Rate, HFR		260	214	190	269	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	147		146			
Peak Hour Factor, PHF	0.75		0.70			
Peak-15 Minute Volume	49		52			
Hourly Flow Rate, HFR	196		208			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		269
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		474	1016		367			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	367	
Potential Capacity	683	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	683	
Probability of Queue free St.	0.70	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	474	
Potential Capacity	1043	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1043	
Probability of Queue free St.	0.82	1.00
Maj L-Shared Prob Q free St.	0.78	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.78	0.78
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	1016	
Potential Capacity	266	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.78
Maj. L, Min T Adj. Imp Factor.		0.83
Cap. Adj. factor due to Impeding mvmnt	0.82	0.58
Movement Capacity	218	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor 1.00 1.00
 Cap. Adj. factor due to Impeding mvmnt 0.78 0.78
 Movement Capacity

Result for 2 stage process:
 a
 y
 C t
 Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows 1016
 Potential Capacity 266
 Pedestrian Impedance Factor 1.00 1.00
 Maj. L, Min T Impedance factor 0.78
 Maj. L, Min T Adj. Imp Factor. 0.83
 Cap. Adj. factor due to Impeding mvmnt 0.82 0.58
 Movement Capacity 218

Results for Two-stage process:
 a
 y
 C t 218

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	196		208			
Movement Capacity (vph)	218		683			
Shared Lane Capacity (vph)		336				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	218		683			
Volume	196		208			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		336				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		190		404				
C(m) (vph)		1043		336				
v/c		0.18		1.20				
95% queue length		0.66		17.27				
Control Delay		9.2		150.0				
LOS		A		F				
Approach Delay				150.0				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.82
v(i1), Volume for stream 2 or 5		269
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.78
d(M,LT), Delay for stream 1 or 4		9.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		2.0

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 08/19/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	284	34	382	0	224	317	123	255	9
Lane Width	15.5			11.0 10.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 708 1699 0.02 0.42 10.3 B 10.3 B

Westbound

LT 530 1272 0.69 0.42 21.1 C 26.7 C
 R 514 1233 0.85 0.42 31.4 C

Northbound

LTR 711 1706 0.90 0.42 31.0 C 31.0 C

Southbound

LTR 299 717 1.48 0.42 252.8 F 252.8 F

Intersection Delay = 81.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/19/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	284	34	382	0	224	317	123	255	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	82	10	110	0	66	93	35	73	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			365	439		637			444	
%InSharedLn												
Prop LTS		0.273			0.893			0.000			0.318	
Prop RTS	0.091			0.000	1.000		0.586			0.023		
Peds Bikes	0			0	0		0			0		
Buses	0			0	0		4			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	284	34	382	0	224	317	123	255	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	326	39	439	0	264	373	141	293	10
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			365 439			637			444		
Prop LTs	0.273			0.893			0.000			0.318		
Prop RTs	0.091			0.000 1.000			0.586			0.023		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.921			0.997		
fLT	0.936			0.741			1.000			0.375		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1699			1272 1233			1706			717		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1699	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	365	1272	0.29	0.42	530	0.69
Right	R	439	1233	# 0.36	0.42	514	0.85
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	637	1706	0.37	0.42	711	0.90
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	444	717	# 0.62	0.42	299	1.48
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.98

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.17

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.69	0.42	14.3	1.000	530	0.50	6.7	0.0	21.1	C	26.7	C
R	0.85	0.42	15.8	1.000	514	0.50	15.6	0.0	31.4	C		
Northbound												
LTR	0.90	0.42	16.3	1.000	711	0.50	14.7	0.0	31.0	C	31.0	C
Southbound												
LTR	1.48	0.42	17.5	1.000	299	0.50	235.3	0.0	252.8	F	252.8	F

Intersection delay = 81.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	326	0	141
Proportion of LT in LT lane group, PLT	0.273	0.893	0.000	0.318
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.32	0.00
Adjusted opposing flow rate, Vo (veh/h)	365	11	444	637
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.43	0.00	2.35
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.08	0.18	7.40	10.62
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	0.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	6.04	0.00	7.82	11.88
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	17.18	13.12
n=Max(gq-gf)/2,0)	0.00	0.00	3.91	5.57
PTHo=1-PLTo	0.11	0.73	0.68	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.32
EL1 (refer to Exhibit C16-3)	2.01	1.39	2.17	2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	2.44	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdifff=max(gq-gf,0)	0.00	0.00	7.82	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.38
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.936	0.741	1.000	0.375

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	6.04			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.242			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	365			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	25.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	21.1
R	0.0	0.00	17.5	15.8	0.00	0.0	0.0	31.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	16.3	0.00	0.0	0.0	31.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	36.3	0.0	252.8
	0.0						0.0	

Intersection Delay	81.0	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		LTR		
Init Queue	0.0			0.0	0.0	0.0		0.0		
Flow Rate	11			365	439	637		444		
So	1900			1900	1900	1900		1900		
No.Lanes	0	1	0	0	1	1	0	0	1	0
SL	1699			1272	1233	1706		717		
LnCapacity	708			530	514	711		299		
Flow Ratio	0.0			0.3	0.4	0.4		0.6		
v/c Ratio	0.02			0.69	0.85	0.90		1.48		
Grn Ratio	0.42			0.42	0.42	0.42		0.42		
I Factor	1.000			0.940		0.887		1.000		
AT or PVG	3			3	3	3		3		
Pltn Ratio	1.00			1.00	1.00	1.00		1.00		
PF2	1.00			1.00	1.00	1.00		1.00		
Q1	0.1			5.0	6.6	9.9		7.4		
kB	0.7			0.5	0.5	0.6		0.4		
Q2	0.0			1.1	2.4	3.7		19.2		
Q Average	0.1			6.1	9.0	13.6		26.6		
Q Spacing	25.0			25.0	25.0	25.0		25.0		
Q Storage	0			0	0	0		0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2		
BOQ	0.2			7.5	10.9	16.4		31.9		
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.4	1.4		1.4		
BOQ	0.2			9.0	13.0	19.3		37.3		
QSRatio										
90th Percentile Output:										
fB%	2.0			1.6	1.6	1.5		1.5		
BOQ	0.2			10.0	14.2	20.8		40.0		
QSRatio										
95th Percentile Output:										
fB%	2.6			1.9	1.8	1.7		1.6		
BOQ	0.3			11.5	15.9	22.6		42.7		
QSRatio										
98th Percentile Output:										
fB%	3.2			2.1	1.9	1.8		1.7		
BOQ	0.4			13.0	17.5	24.4		45.4		
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				160		5		536			539	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 631 1894 0.30 0.33 15.9 B 15.9 B

Northbound

T 970 1940 0.65 0.50 14.1 B 14.1 B

Southbound

T 925 1850 0.67 0.50 14.2 B 14.2 B

Intersection Delay = 14.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				160		5	536			539		
% Heavy Veh				8		8	11			15		
PHF				0.88		0.88	0.85			0.87		
PK 15 Vol				45		2	158			155		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					188		631			620		
%InSharedLn												
Prop LTs					0.968		0.000			0.000		
Prop RTs					0.032		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			3		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.893			0.886			0.754		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0						30.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				160		5	536			539		
PHF				0.88		0.88	0.85			0.87		
Adj flow				182		6	631			620		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					188			631			620	
Prop LTs					0.968			0.000			0.000	
Prop RTs					0.032			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.926			0.901			0.870	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.988	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.996			1.000			1.000	
FLT					0.954			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1894			1940			1850	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	188	1894	# 0.10	0.33	631	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	631	1940	0.33	0.50	970	0.65
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	620	1850	# 0.34	0.50	925	0.67
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.43
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.52

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.30	0.33	14.8	1.000	631	0.50	1.1	0.0	15.9	B	15.9	B
Northbound												
T	0.65	0.50	11.1	1.000	970	0.50	3.0	0.0	14.1	B	14.1	B
Southbound												
T	0.67	0.50	11.3	1.000	925	0.50	2.9	0.0	14.2	B	14.2	B

Intersection delay = 14.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.968 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	14.8	0.00	0.0	0.0	15.9
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.1	0.00	0.0	0.0	14.1
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.3	0.00	0.0	0.0	14.2
	0.0						0.0	
Intersection Delay			14.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		536	223			189	510	
Peak-Hour Factor, PHF		0.85	0.85			0.87	0.87	
Hourly Flow Rate, HFR		630	262			217	586	
Percent Heavy Vehicles		--	--			20	--	--
Median Type/Storage		Undivided			/			
RT Channelized?		No						
Lanes		1	1			1	1	
Configuration		T	R			L	T	
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume								
Peak Hour Factor, PHF								
Hourly Flow Rate, HFR								
Percent Heavy Vehicles								
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			/
Lanes								
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4		7	8	9		10 11 12
Lane Config		L						
v (vph)		217						
C(m) (vph)		690						
v/c		0.31						
95% queue length		1.35						
Control Delay		12.6						
LOS		B						
Approach Delay								
Approach LOS								

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: So Bridge St & Arthur Kill Rd
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: South Bridge Street
North/South Street: Arthur Kill Road
Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		536	223	189	510	
Peak-Hour Factor, PHF		0.85	0.85	0.87	0.87	
Peak-15 Minute Volume		158	66	54	147	
Hourly Flow Rate, HFR		630	262	217	586	
Percent Heavy Vehicles		--	--	20	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		20						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		20						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		892						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	892	
Potential Capacity	690	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	690	
Probability of Queue free St.	0.69	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.69 0.69
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.69 0.69
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L						
v (vph)		217						
C(m) (vph)		690						
v/c		0.31						
95% queue length		1.35						
Control Delay		12.6						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.69
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		12.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				62		206	549	74		145	359	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 381 1430 0.76 0.27 33.2 C 33.2 C

Northbound

TR 1033 1823 0.71 0.57 12.6 B 12.6 B

Southbound

LT 568 1003 1.02 0.57 53.1 D 53.1 D

Intersection Delay = 31.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				62		206	549	74		145	359	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				17		55	161	22		42	103	
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					289			733			580	
%InSharedLn												
Prop LTs					0.232			0.000			0.288	
Prop RTs					0.768			0.119			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.980			0.769			0.842		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				62		206	549	74		145	359	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
Adj flow				67		222	646	87		167	413	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					289			733			580	
Prop LTs					0.232			0.000			0.288	
Prop RTs					0.768			0.119			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.901			0.917	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.988	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.896			0.984			1.000	
fLT					0.989			1.000			0.529	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1430			1823			1003	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	289	1430	# 0.20	0.27	381	0.76
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	733	1823	0.40	0.57	1033	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	580	1003	# 0.58	0.57	568	1.02
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
----------------------	---------------	------------------	---------------------	--------------------	----------------------------	------------------	------------------	-------------------------	--	-----------------------	--

Eastbound

Westbound

LR 0.76 0.27 20.2 1.000 381 0.50 13.0 0.0 33.2 C 33.2 C

Northbound

TR 0.71 0.57 9.4 1.000 1033 0.50 3.2 0.0 12.6 B 12.6 B

Southbound

LT 1.02 0.57 13.0 1.000 568 0.50 40.1 0.0 53.1 D 53.1 D

Intersection delay = 31.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			167
Proportion of LT in LT lane group, PLT	0.232	0.000	0.288
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			733
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.78
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.22
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.29
n=Max(gq-gf)/2,0)			3.55
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.29
EL1 (refer to Exhibit C16-3)			2.89
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.53
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.529

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.71
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.256
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				733
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.288
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.768	0.119
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.2	0.00	0.0	0.0	33.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.4	0.00	0.0	0.0	12.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	3.0	0.0	53.1
	0.0						0.0	
Intersection Delay			31.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	71	53	94	23	161	50	90	672	112	67	367	30
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			6		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	560	1627	0.43	0.34	24.7	C	24.7	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	579	1682	0.43	0.34	25.0	C	25.0	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	397	729	0.25	0.54	11.8	B		
TR	1048	1925	0.81	0.54	21.3	C	20.4	C

Southbound

LTR	952	1749	0.57	0.54	16.1	B	16.1	B
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 20.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	71	53	94	23	161	50	90	672	112	67	367	30
% Heavy Veh	1	1	1	1	1	1	3	3	3	9	9	9
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
PK 15 Vol	20	15	26	6	43	13	24	183	30	20	109	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			6
Adj Flow		242			248		98	852			546	
%InSharedLn												
Prop LTs		0.326			0.097		1.000	0.000			0.147	
Prop RTs		0.430			0.214			0.143			0.053	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.810			1.000			0.649			0.986	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	71	53	94	23	161	50	90	672	112	67	367	30
PHF	0.90	0.90	0.90	0.94	0.94	0.94	0.92	0.92	0.92	0.84	0.84	0.84
Adj flow	79	59	104	24	171	53	98	730	122	80	437	29
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	242			248			98 852			546		
Prop LTs	0.326			0.097			1.000 0.000			0.147		
Prop RTs	0.430			0.214			0.143			0.053		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.971 0.971			0.917		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.942			0.971			0.979			0.992		
fLT	0.810			0.956			0.423 1.000			0.596		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1627			1682			729 1925			1749		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	242	1627	# 0.15	0.34	560	0.43
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	248	1682	0.15	0.34	579	0.43
Right							
Northbound							
Prot							
Perm							
Left	L	98	729	0.13	0.54	397	0.25
Prot							
Perm							
Thru	TR	852	1925	# 0.44	0.54	1048	0.81
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	546	1749	0.31	0.54	952	0.57
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.59
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.67

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.43	0.34	22.7	1.000	560	0.50	2.0	0.0	24.7	C	24.7	C
Westbound												
LTR	0.43	0.34	22.7	1.000	579	0.50	2.3	0.0	25.0	C	25.0	C
Northbound												
L	0.25	0.54	10.8	1.000	397	0.50	1.0	0.0	11.8	B		
TR	0.81	0.54	16.8	1.000	1048	0.50	4.6	0.0	21.3	C	20.4	C
Southbound												
LTR	0.57	0.54	13.6	1.000	952	0.50	2.5	0.0	16.1	B	16.1	B

Intersection delay = 20.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			98	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.15	
Adjusted opposing flow rate, Vo (veh/h)			546	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.45	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.17	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			2.77	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			46.23	
n=Max(gq-gf)/2,0)			1.38	
PTHo=1-PLTo			0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.23	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.34	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			2.77	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.42	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.423	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	79	24	80
Proportion of LT in LT lane group, PLT	0.326	0.097	0.000
Proportion of LT in opposing flow, PLTo	0.10	0.33	0.00
Adjusted opposing flow rate, Vo (veh/h)	248	242	852
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	1.98	0.60	2.00
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.20	6.05	21.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	3.3	11.6	6.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	7.68	7.45	31.85
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.32	19.38	17.15
n=Max(gq-gf)/2,0)	2.20	0.00	12.68
PTHo=1-PLTo	0.90	0.67	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.33	0.10	0.59
EL1 (refer to Exhibit C16-3)	1.78	1.77	3.24
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.07	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.07
gdifff=max(gq-gf,0)	4.40	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.81	0.96	0.28
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.810	0.956	0.596

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	7.68	7.45	2.77	31.85
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.248	0.240	0.057	0.650
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	248	242	546	852
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.326	0.097	1.000	0.147
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.430	0.214	0.143	0.053
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	22.7	0.00	0.0	0.0 0.0 0.0	24.7
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	22.7	0.00	0.0	0.0 0.0 0.0	25.0
Northbound								
L	0.0	0.00	20.5	10.8	0.00	0.0	0.0	11.8
TR	0.0 0.0	0.00	20.5	16.8	0.00	0.0	0.0 0.0	21.3
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	13.6	0.00	0.0	0.0 0.0 0.0	16.1
Intersection Delay			20.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	242		248		98	852	286	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1627		1682		729	1925	918	
LnCapacity	560		579		397	1048	499	
Flow Ratio	0.1		0.1		0.1	0.4	0.3	
v/c Ratio	0.43		0.43		0.25	0.81	0.57	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.810		1.000			0.649	0.986	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	4.7		4.8		1.3	17.4	4.7	
kB	0.6		0.8		0.4	0.8	0.7	
Q2	0.5		0.6		0.1	3.0	0.9	
Q Average	5.1		5.3		1.4	20.4	5.6	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	6.3		6.6		1.8	24.5	6.9	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.6	1.4	1.5	
BOQ	7.7		8.0		2.3	28.6	8.4	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.7		1.9	1.5	1.7	
BOQ	8.6		8.9		2.7	30.7	9.4	
QSRatio								
95th Percentile Output:								
fB%	2.0		1.9		2.4	1.6	1.9	
BOQ	10.0		10.4		3.3	33.0	10.8	
QSRatio								
98th Percentile Output:								
fB%	2.2		2.2		2.8	1.7	2.2	
BOQ	11.5		11.8		4.0	35.2	12.3	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With Action Alt 2
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	353							793			405	
Lane Width	16.0							14.5			12.0	
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	669	2006	0.59	0.33	28.6	C	28.6	C

Westbound

Northbound

T 2156 3880 0.40 0.56 11.8 B 11.8 B

Southbound

T 1951 3512 0.25 0.56 10.6 B 10.6 B

Intersection Delay = 15.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	353						793			405		
% Heavy Veh	2						1			3		
PHF	0.90						0.91			0.84		
PK 15 Vol	98						218			121		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	392						871			482		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.665			0.986		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	353						793			405		
PHF	0.90						0.91			0.84		
Adj flow	392						871			482		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	392						871			482		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.980							0.990				0.971			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2006							3880				3512			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	392	2006	# 0.20	0.33	669	0.59
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	871	3880	# 0.22	0.56	2156	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	482	3512	0.14	0.56	1951	0.25
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.59	0.33	24.9	1.000	669	0.50	3.7	0.0	28.6	C	28.6	C	
Westbound													
Northbound													
T	0.40	0.56	11.5	1.000	2156	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.25	0.56	10.3	1.000	1951	0.50	0.3	0.0	10.6	B	10.6	B	

Intersection delay = 15.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	24.9	0.00	0.0	0.0	28.6
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.5	0.00	0.0	0.0	11.8
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.3	0.00	0.0	0.0	10.6
	0.0						0.0	
Intersection Delay			15.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	392						457		253	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2006						2037		1844	
LnCapacity	669						1132		1024	
Flow Ratio	0.2						0.2		0.1	
v/c Ratio	0.59						0.40		0.25	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.665		0.986	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	8.1						6.5		3.3	
kB	0.9						0.8		1.1	
Q2	1.2						0.6		0.4	
Q Average	9.3						7.1		3.6	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	11.3						8.7		4.5	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	13.5						10.5		5.6	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	14.7						11.5		6.3	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		2.1	
BOQ	16.3						13.1		7.6	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.4	
BOQ	18.0						14.6		8.8	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					405	
Peak-Hour Factor, PHF					0.84	
Peak-15 Minute Volume					121	
Hourly Flow Rate, HFR					482	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						59
Peak Hour Factor, PHF						0.70
Peak-15 Minute Volume						21
Hourly Flow Rate, HFR						84
Percent Heavy Vehicles						60
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								60
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								60
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								241
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		241
Potential Capacity		674
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		674
Probability of Queue free St.	1.00	0.88

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	557
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	557
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	557	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	557	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	625
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	625

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	804	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity	704	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.88	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						84
Movement Capacity (vph)						674
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						674
Volume						84
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								84
C(m) (vph)								674
v/c								0.12
95% queue length								0.42
Control Delay								11.1
LOS								B
Approach Delay							11.1	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	73	194	169	203	523	79	180	251	74	68	31	41
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	156	468	0.53	0.33	34.1	C		
TR	583	1750	0.63	0.33	29.4	C	30.3	C
Westbound								
L	193	579	1.21	0.33	161.1	F		
TR	1096	3287	0.63	0.33	27.9	C	61.7	E
Northbound								
LTR	909	3272	0.60	0.28	31.1	C	31.1	C
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	350	1574	0.31	0.22	31.4	C	31.1	C

Intersection Delay = 44.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	73	194	169	203	523	79	180	251	74	68	31	41
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	21	55	48	58	150	23	48	67	20	25	12	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	83	369		233	687			544		101	107	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.357			0.000	
Prop RTs		0.404			0.125			0.147			0.570	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	73	194	169	203	523	79	180	251	74	68	31	41
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	83	220	149	233	601	86	194	270	80	101	46	61
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L TR			L TR			L TR			L TR		
Adj flow	83	369		233	687		544			101	107	
Prop LTs	1.000	0.000		1.000	0.000		0.357			0.000		
Prop RTs	0.404			0.125			0.147			0.570		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.980	0.980		0.926	0.926		0.926			0.971	0.971	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.939			0.981		0.978				0.914	
fLT	0.260	1.000		0.353	1.000		0.982			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	468	1750		579	3287		3272			1694	1574	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	83	468	0.18	0.33	156	0.53
Prot							
Perm							
Thru	TR	369	1750	0.21	0.33	583	0.63
Right							
Westbound							
Prot							
Perm							
Left	L	233	579	# 0.40	0.33	193	1.21
Prot							
Perm							
Thru	TR	687	3287	0.21	0.33	1096	0.63
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	544	3272	# 0.17	0.28	909	0.60
Right							
Southbound							
Prot							
Perm							
Left	L	101	1694	0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	107	1574	# 0.07	0.22	350	0.31
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.64$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.76$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.53	0.33	24.3	1.000	156	0.50	9.8	0.0	34.1	C		
TR	0.63	0.33	25.3	1.000	583	0.50	4.1	0.0	29.4	C	30.3	C
Westbound												
L	1.21	0.33	30.0	1.000	193	0.50	131.1	0.0	161.1	F		
TR	0.63	0.33	25.3	1.000	1096	0.50	2.7	0.0	27.9	C	61.7	E
Northbound												
LTR	0.60	0.28	28.2	1.000	909	0.50	2.9	0.0	31.1	C	31.1	C
Southbound												
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C		
TR	0.31	0.22	29.2	1.000	350	0.50	2.2	0.0	31.4	C	31.1	C

Intersection delay = 44.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	83	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	687	369		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	2.08	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.02	9.23		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.04	10.47		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.96	19.53		
n=Max(gq-gf)/2,0)	5.02	5.24		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.56	1.85		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.35		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.260	0.353		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.357 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.04			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.335			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	687			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	24.3	0.00	0.0	0.0	34.1
TR	0.0	0.00	30.0	25.3	0.00	0.0	0.0	29.4
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	10.0	0.0	161.1
TR	0.0	0.00	30.0	25.3	0.00	0.0	0.0	27.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.2	0.00	0.0	0.0	31.1
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	29.2	0.00	0.0	0.0	31.4
	0.0						0.0	
Intersection Delay			44.1	sec/veh	Intersection LOS D			

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	83	369		233	360		285			101	107	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	468	1750		579	1726		1718			1694	1574	
LnCapacity	156	583		193	575		477			376	350	
Flow Ratio	0.2	0.2		0.4	0.2		0.2			0.1	0.1	
v/c Ratio	0.53	0.63		1.21	0.63		0.60			0.27	0.31	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.7	7.8		5.8	7.6		6.2			2.1	2.2	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.3	1.0		6.6	1.2		1.0			0.2	0.2	
Q Average	1.9	8.8		12.4	8.8		7.1			2.3	2.5	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	2.5	10.7		15.0	10.7		8.7			2.9	3.1	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.6	
BOQ	3.1	12.8		17.7	12.8		10.5			3.7	3.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.6		1.5	1.6		1.6			1.8	1.8	
BOQ	3.6	14.0		19.1	14.0		11.6			4.2	4.5	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.8		1.7	1.8		1.8			2.2	2.2	
BOQ	4.4	15.6		20.9	15.6		13.1			5.1	5.5	
QSRatio												
98th Percentile Output:												
fB%	2.7	2.0		1.8	2.0		2.1			2.6	2.6	
BOQ	5.3	17.2		22.6	17.2		14.7			6.1	6.5	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						404		
Peak-Hour Factor, PHF						0.95		
Hourly Flow Rate, HFR						425		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		178						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		191						
Percent Heavy Vehicles		8						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			191						
C(m) (vph)			575						
v/c			0.33						
95% queue length			1.45						
Control Delay			14.3						
LOS			B						
Approach Delay				14.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 404
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 106
 Hourly Flow Rate, HFR 425
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 48
 Hourly Flow Rate, HFR 191
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			425					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	425	
Potential Capacity	575	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	575	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 425
Potential Capacity 575
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 575

Results for Two-stage process:
a
y
C t 575

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	191					
Movement Capacity (vph)	575					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	575					
Volume	191					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			191					
C(m) (vph)			575					
v/c			0.33					
95% queue length			1.45					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	69	28	33	92	67	14	16	21	21	52	16
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.80	0.80	0.78	0.78	0.86	0.86	1.00	1.00
Flow Rate	49	77	100	143	34	24	47	42
% Heavy Veh	21	21	1	1	5	5	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	49	77	100	143	34	24	47	42
Left-Turn	7	0	42	0	16	0	21	0
Right-Turn	0	34	0	85	0	24	0	16
Prop. Left-Turns	0.1	0.0	0.4	0.0	0.5	0.0	0.4	0.0
Prop. Right-Turns	0.0	0.4	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7	-0.7	-0.7	-0.7
hHV-adj	1.7	1.7	1.7	1.7
hadj, computed	0.4	0.0	0.2	-0.4
	0.3	-0.6	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	49	77	100	143	34	24	47	42
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.04	0.07	0.09	0.13	0.03	0.02	0.04	0.04
hd, final value	5.53	5.15	5.24	4.61	5.79	4.86	5.66	5.17
x, final value	0.08	0.11	0.15	0.18	0.05	0.03	0.07	0.06
Move-up time, m		2.3		2.3		2.3		2.3
Service Time	3.2	2.9	2.9	2.3	3.5	2.6	3.4	2.9

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	49	77	100	143	34	24	47	42
Service Time	3.2	2.9	2.9	2.3	3.5	2.6	3.4	2.9
Utilization, x	0.08	0.11	0.15	0.18	0.05	0.03	0.07	0.06
Dep. headway, hd	5.53	5.15	5.24	4.61	5.79	4.86	5.66	5.17
Capacity	299	327	350	393	284	274	297	292
Delay	8.68	8.49	8.83	8.34	8.83	7.72	8.81	8.20
LOS	A	A	A	A	A	A	A	A
Approach:								
Delay		8.57		8.54		8.37		8.52
LOS		A		A		A		A
Intersection Delay	8.52							

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	54	43	227	177	437	6	270	93	51	11	160	102
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	760	2973	0.48	0.26	30.5	C	30.5	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	884	3458	0.81	0.26	38.8	D	38.8	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	303	940	1.02	0.32	88.3	F		
TR	576	1787	0.29	0.32	24.0	C	65.9	E

Southbound

LTR	880	2732	0.41	0.32	25.2	C	25.2	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 41.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	54	43	227	177	437	6	270	93	51	11	160	102
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	12	64	51	126	2	78	27	15	4	53	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		368			712		310	166			359	
%InSharedLn												
Prop LTs		0.166			0.285		1.000	0.000			0.039	
Prop RTs		0.701			0.010			0.355			0.373	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	54	43	227	177	437	6	270	93	51	11	160	102
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	61	49	258	203	502	7	310	107	59	14	211	134
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	368			712			310 166			359		
Prop LTs	0.166			0.285			1.000 0.000			0.039		
Prop RTs	0.701			0.010			0.355			0.373		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.926			0.971			0.962 0.962			0.926		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.895			0.999			0.947			0.944		
fLT	0.992			0.986			0.498 1.000			0.943		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2973			3458			940 1787			2732		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	368	2973	# 0.12	0.26	760	0.48
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	712	3458	# 0.21	0.26	884	0.81
Right							
Northbound							
Prot							
Perm							
Left	DefL	310	940	# 0.33	0.32	303	1.02
Prot							
Perm							
Thru	TR	166	1787	0.09	0.32	576	0.29
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	359	2732	0.13	0.32	880	0.41
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.66
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.79

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.48	0.26	28.5	1.000	760	0.50	2.0	0.0	30.5	C	30.5	C	
Westbound													
LTR	0.81	0.26	31.4	1.000	884	0.50	7.4	0.0	38.8	D	38.8	D	
Northbound													
DefL	1.02	0.32	30.5	1.000	303	0.50	57.8	0.0	88.3	F			
TR	0.29	0.32	22.8	1.000	576	0.50	1.3	0.0	24.0	C	65.9	E	
Southbound													
LTR	0.41	0.32	23.8	1.000	880	0.50	1.4	0.0	25.2	C	25.2	C	

Intersection delay = 41.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			310	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.04	
Adjusted opposing flow rate, Vo (veh/h)			359	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.75	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			4.71	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			2.14	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			26.86	
n=Max(gq-gf)/2,0)			1.07	
PTHo=1-PLTo			0.96	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.86	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.07	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			2.14	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.50	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.498	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	14
Proportion of LT in LT lane group, PLT	0.166 0.285 0.000 0.039
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	166
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.35
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	14.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	14.86
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	1.64
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.943

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.000
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				166
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.039
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.701	0.010	0.355
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	28.5	0.00	0.0	0.0	30.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	31.4	0.00	0.0	0.0	38.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	1.7	0.0	88.3
TR	0.0	0.00	30.5	22.8	0.00	0.0	0.0	24.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	23.8	0.00	0.0	0.0	25.2
	0.0						0.0	
Intersection Delay			41.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			LTR			DefL	TR	LTR			
Init Queue	0.0			0.0			0.0	0.0	0.0			
Flow Rate	193			373			310	166	188			
So	1900			1900			1900	1900	1900			
No.Lanes	0	2	0	0	2	0	0	2	0	0	2	0
SL	1561			1816			940	1787	1434			
LnCapacity	399			464			303	576	462			
Flow Ratio	0.1			0.2			0.3	0.1	0.1			
v/c Ratio	0.48			0.80			1.02	0.29	0.41			
Grn Ratio	0.26			0.26			0.32	0.32	0.32			
I Factor	0.916			0.953			1.000		1.000			
AT or PVG	3			3			3	3	3			
Pltn Ratio	1.00			1.00			1.00	1.00	1.00			
PF2	1.00			1.00			1.00	1.00	1.00			
Q1	4.1			8.7			7.8	3.1	3.7			
kB	0.5			0.6			0.5	0.8	0.7			
Q2	0.5			2.2			4.8	0.3	0.5			
Q Average	4.6			10.9			12.6	3.4	4.1			
Q Spacing	25.0			25.0			25.0	25.0	25.0			
Q Storage	0			0			0	0	0			
Q S Ratio												
70th Percentile Output:												
fB%	1.2			1.2			1.2	1.3	1.2			
BOQ	5.7			13.2			15.2	4.3	5.1			
QSRatio												
85th Percentile Output:												
fB%	1.5			1.4			1.4	1.6	1.5			
BOQ	7.0			15.7			17.9	5.3	6.3			
QSRatio												
90th Percentile Output:												
fB%	1.7			1.6			1.5	1.8	1.7			
BOQ	7.8			17.0			19.4	6.0	7.1			
QSRatio												
95th Percentile Output:												
fB%	2.0			1.7			1.7	2.1	2.0			
BOQ	9.2			18.7			21.2	7.2	8.4			
QSRatio												
98th Percentile Output:												
fB%	2.3			1.9			1.8	2.5	2.4			
BOQ	10.6			20.4			22.9	8.4	9.7			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	868	259	19	4	284	327	4	16	6	121	5	146
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	839	1728	1.14	0.71	89.7	F		
TR	1158	1629	0.26	0.71	5.0	A	69.2	E
Westbound								
LT	449	1835	0.75	0.24	41.5	D	60.1	E
R	383	1568	0.99	0.24	76.4	E		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.62	0.18	46.1	D		
LT	320	1801	0.02	0.18	30.6	C	24.7	C
R	952	1478	0.18	0.64	6.8	A		

Intersection Delay = 59.4 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	868	259	19	4	284	327	4	16	6	121	5	146
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	238	71	5	1	83	95	3	11	4	35	2	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	954	306			335	380		70		139	6	168
%InSharedLn										0		
Prop LTs	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTs		0.069			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	868	259	19	4	284	327	4	16	6	121	5	146
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
Adj flow	954	285	21	5	330	380	11	43	16	139	6	168
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	954	306			335	380		70		139	6	168
Prop LTs	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTs		0.069			0.000	1.000		0.229			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.971	0.971		0.990			0.980	0.980	0.980
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.990		1.000	0.850		0.969				1.000	0.850
fLT	0.950	1.000		0.995			0.965			0.732	1.000	
Sec.	0.237											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1629		1835	1568		1995			1273	1801	1478
Sec.	431											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		710	1728	# 0.41	0.411	710	1.00
Perm		244	431	# 0.57	0.300	129	1.89
Left	L	954			0.71	839	1.14
Prot							
Perm							
Thru	TR	306	1629	0.19	0.71	1158	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	335	1835	0.18	0.24	449	0.75
Right	R	380	1568	0.24	0.24	383	0.99
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	139	1273	# 0.11	0.18	226	0.62
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	168	1478	0.11	0.64	952	0.18

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.09
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.22

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.14	0.71	18.7	1.000	839	0.50	71.0	0.0	89.7	F			
TR	0.26	0.71	4.6	1.000	1158	0.50	0.3	0.0	5.0	A	69.2	E	
Westbound													
LT	0.75	0.24	31.4	1.000	449	0.50	10.1	0.0	41.5	D	60.1	E	
R	0.99	0.24	33.9	1.000	383	0.50	42.5	0.0	76.4	E			
Northbound													
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C	
Southbound													
L	0.62	0.18	34.2	1.000	226	0.50	11.9	0.0	46.1	D			
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	24.7	C	

R 0.18 0.64 6.4 1.000 952 0.50 0.4 0.0 6.8 A

Intersection delay = 59.4 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	954			139
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.16
Adjusted opposing flow rate, Vo (veh/h)	335			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLT/3600	23.85			3.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.38			1.75
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	15.55			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	11.45			14.85
n=Max(gq-gf)/2,0)	7.77			0.58
PTHo=1-PLTo	0.99			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.79			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.39			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	15.55			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.24			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.237			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.015	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	306	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.65	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.96	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.89	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.995	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		306		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.015		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.069
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	954			
v/c ratio from Capacity Worksheet, X	1.14			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	15.55			
Unopposed green interval, gu	11.45			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	1.95			
XProt	0.83			
Case	3			
Queue at beginning of green arrow, Qa	9.12			
Queue at beginning of unsaturated green, Qu	3.62			
Residual queue, Qr	3.06			
Uniform Delay, d1	18.7			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		18.7	0.00	28.7	0.0	89.7
TR	0.0	0.00	13.0	4.6	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	31.4	0.00	0.0	0.0	41.5
R	0.0	0.00	34.0	33.9	0.00	0.0	0.0	76.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	34.2	0.00	0.0	0.0	46.1
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	16.0	6.4	0.00	0.0	0.0	6.8
Intersection Delay			59.4	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	954	306		335	380	70		139	6	168
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1181	1629		1835	1568	1995		1273	1801	1478
LnCapacity	839	1158		449	383	355		226	320	952
Flow Ratio	0.8	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	1.14	0.26		0.75	0.99	0.20		0.62	0.02	0.18
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	11.7	2.7		7.7	9.5	1.5		3.2	0.1	1.7
kB	0.6	0.8		0.6	0.5	0.6		0.4	0.5	1.1
Q2	18.3	0.3		1.6	4.9	0.1		0.6	0.0	0.2
Q Average	30.0	3.0		9.3	14.4	1.6		3.8	0.1	1.9
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2	1.2	1.3		1.2	1.3	1.3
BOQ	36.1	3.8		11.4	17.3	2.1		4.8	0.2	2.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.4	1.4	1.6		1.5	1.7	1.6
BOQ	42.1	4.7		13.5	20.4	2.6		5.9	0.2	3.1
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6	1.5	1.9		1.7	2.0	1.8
BOQ	45.1	5.3		14.7	22.0	3.0		6.6	0.3	3.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.8	1.7	2.3		2.1	2.6	2.3
BOQ	48.1	6.4		16.4	23.8	3.8		7.9	0.3	4.4
QSRatio										
98th Percentile Output:										
fB%	1.7	2.5		1.9	1.8	2.8		2.4	3.2	2.7
BOQ	51.2	7.6		18.0	25.7	4.5		9.2	0.4	5.2
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/9/2013	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Hour	Year : 2020 With-Action Alt 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	361	26	0	14	68	38	6	21	11	15	38	512
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			9			0			155

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	P				NB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
WB	Left	P				SB	Left	P			
	Thru	P					Thru	P			
	Right	P					Right	P			
	Peds	X					Peds	X			
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		45.0						35.0			
Yellow		3.0						3.0			
All Red		2.0						2.0			

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	699	1397	0.57	0.50	18.9	B		
TR	1066	2132	0.03	0.50	11.5	B	18.4	B

LTR	1543	3086	0.10	0.50	12.0	B	12.0	B
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LTR	1232	3168	0.07	0.39	17.4	B	17.4	B
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LT	673	1730	0.10	0.39	17.8	B	30.5	C
R	616	1583	0.76	0.39	32.4	C		

Intersection Delay = 22.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	361	26	0	14	68	38	6	21	11	15	38	512	
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2	
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76	
PK 15 Vol	99	7	0	5	24	13	3	12	6	5	13	168	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900			1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R	
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0	
RTOR Vol			0			9			0			155	
Adj Flow	397	29			153			84			70	470	
%InSharedLn													
Prop LTs	1.000	0.000			0.124			0.155			0.286		
Prop RTs		0.000			0.261			0.286			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0			0			0	0	
%InProtPhase													
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.970			1.000			1.000			0.974	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	361	26	0	14	68	38	6	21	11	15	38	512
PHF	0.91	0.91	0.91	0.72	0.72	0.72	0.45	0.45	0.45	0.76	0.76	0.76
Adj flow	397	29	0	19	94	40	13	47	24	20	50	470
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	397	29			153			84			70	470
Prop LTs	1.000	0.000			0.124			0.155			0.286	
Prop RTs		0.000			0.261			0.286			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.971			0.990		0.980	0.980
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.961			0.957		1.000	0.850
fLT	0.655	1.000			0.930			0.924		0.929	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1397	2132			3086			3168		1730	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	397	1397	# 0.28	0.50	699	0.57
Prot							
Perm							
Thru	TR	29	2132	0.01	0.50	1066	0.03
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	153	3086	0.05	0.50	1543	0.10
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	84	3168	0.03	0.39	1232	0.07
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	70	1730	0.04	0.39	673	0.10
Right	R	470	1583	# 0.30	0.39	616	0.76

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.65

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.57	0.50	15.7	1.000	699	0.50	3.2	0.0	18.9	B			
TR	0.03	0.50	11.4	1.000	1066	0.50	0.0	0.0	11.5	B	18.4	B	
Westbound													
LTR	0.10	0.50	11.8	1.000	1543	0.50	0.1	0.0	12.0	B	12.0	B	
Northbound													
LTR	0.07	0.39	17.3	1.000	1232	0.50	0.1	0.0	17.4	B	17.4	B	
Southbound													
LT	0.10	0.39	17.5	1.000	673	0.50	0.3	0.0	17.8	B	30.5	C	

R 0.76 0.39 23.9 1.000 616 0.50 8.5 0.0 32.4 C

Intersection delay = 22.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	397			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.12			
Adjusted opposing flow rate, Vo (veh/h)	153			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	9.93			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	2.01			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.88			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.53			
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.66			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.655			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	19	13	20	
Proportion of LT in LT lane group, PLT	0.000	0.124	0.155	0.286
Proportion of LT in opposing flow, PLTo	0.00	0.29	0.15	
Adjusted opposing flow rate, Vo (veh/h)	29	70	84	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.48	0.33	0.50	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.36	1.75	1.10	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.8	18.6	15.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	23.17	16.40	19.53	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.71	0.85	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.26	0.31	0.29	
EL1 (refer to Exhibit C16-3)	1.42	1.48	1.51	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.08	0.07	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.95	0.94	0.93	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.930	0.924	0.929	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	153	29	70	84
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.124	0.155	0.286
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.261	0.286	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	15.7	0.00	0.0	0.0	18.9
TR	0.0	0.00	22.5	11.4	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	12.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	17.3	0.00	0.0	0.0	17.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.5	0.00	0.0	0.0	17.8
R	0.0	0.00	27.5	23.9	0.00	0.0	0.0	32.4
Intersection Delay			22.9	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	397	29			80				44				70	470	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1397	2132			1620				1663				1730	1583	
LnCapacity	699	1066			810				647				673	616	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.3	
v/c Ratio	0.57	0.03			0.10				0.07				0.10	0.76	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.970			1.000				1.000				0.974		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	6.9	0.4			1.1				0.7				1.1	10.2	
kB	0.9	1.2			1.0				0.8				0.8	0.8	
Q2	1.1	0.0			0.1				0.1				0.1	2.3	
Q Average	8.0	0.4			1.2				0.8				1.2	12.5	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	9.8	0.5			1.5				1.0				1.5	15.1	
QSRatio															
85th Percentile Output:															
fB%	1.5	1.7			1.6				1.7				1.6	1.4	
BOQ	11.7	0.7			1.9				1.2				2.0	17.8	
QSRatio															
90th Percentile Output:															
fB%	1.6	2.0			1.9				1.9				1.9	1.5	
BOQ	12.9	0.8			2.2				1.5				2.3	19.2	
QSRatio															
95th Percentile Output:															
fB%	1.8	2.5			2.4				2.5				2.4	1.7	
BOQ	14.5	1.0			2.8				1.8				2.9	21.0	
QSRatio															
98th Percentile Output:															
fB%	2.0	3.1			2.9				3.0				2.9	1.8	
BOQ	16.1	1.2			3.4				2.2				3.5	22.8	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	107		4				4	100			616	334
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	532	1680	0.25	0.32	16.4	B	16.4	B
R	461	1455	0.00	0.32	14.0	B		
Westbound								

Northbound

LT 1659 3211 0.08 0.52 7.4 A 7.4 A

Southbound

TR 1987 3845 0.59 0.52 11.1 B 11.1 B

Intersection Delay = 11.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	107		4				4	100		616	334	
% Heavy Veh	11		11				2	2		1	1	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
PK 15 Vol	33		1				1	31		190	103	
Hi Ln Vol												
% Grade		0						0				
Ideal Sat	1900		1900					1900				
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			4									0
Adj Flow	134		0					130			1172	
%InSharedLn												
Prop LTs								0.038			0.000	
Prop RTs			1.000					0.000			0.352	
Peds Bikes	0			0						0	0	
Buses	0		0					0		0		
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.995						1.000			0.752	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	107		4				4	100		616	334	
PHF	0.80		0.80				0.80	0.80		0.81	0.81	
Adj flow	134		0				5	125		760	412	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	134		0					130			1172	
Prop LTs								0.038			0.000	
Prop RTs			1.000					0.000			0.352	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.901	0.901			0.980		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.947	
fLT	0.950				0.921		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1680	1455			3211		3845	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	134	1680	# 0.08	0.32	532	0.25
Prot							
Perm							
Thru							
Right	R	0	1455	0.00	0.32	461	0.00
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	130	3211	0.04	0.52	1659	0.08
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1172	3845	# 0.30	0.52	1987	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.25	0.32	15.2	1.000	532	0.50	1.1	0.0	16.4	B	16.4	B	
R	0.00	0.32	14.0	1.000	461	0.50	0.0	0.0	14.0	B			
Westbound													
Northbound													
LT	0.08	0.52	7.3	1.000	1659	0.50	0.1	0.0	7.4	A	7.4	A	
Southbound													
TR	0.59	0.52	10.1	1.000	1987	0.50	1.0	0.0	11.1	B	11.1	B	

Intersection delay = 11.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	5
Proportion of LT in LT lane group, PLT	0.038 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1172
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.08
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.26
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	10.07
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.28
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.08
EL1 (refer to Exhibit C16-3)	4.65
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.93
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.921

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.07	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.325	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1172	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.038	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.352
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	15.2	0.00	0.0	0.0	16.4
	0.0						0.0	
R	0.0	0.00	20.5	14.0	0.00	0.0	0.0	14.0
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.3	0.00	0.0	0.0	7.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	10.1	0.00	0.0	0.0	11.1
	0.0						0.0	
Intersection Delay			11.2	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	134	0				68		615	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1680	1455				1686		2019	
LnCapacity	532	461				871		1043	
Flow Ratio	0.1	0.0				0.0		0.3	
v/c Ratio	0.25	0.00				0.08		0.59	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.995				1.000		0.752	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	1.7	0.0				0.6		7.1	
kB	0.6	0.5				0.8		0.7	
Q2	0.2	0.0				0.1		0.9	
Q Average	1.8	0.0				0.6		8.1	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3				1.3		1.2	
BOQ	2.3	0.0				0.8		9.8	
QSRatio									
85th Percentile Output:									
fB%	1.6	1.7				1.7		1.5	
BOQ	3.0	0.0				1.1		11.8	
QSRatio									
90th Percentile Output:									
fB%	1.8	2.0				1.9		1.6	
BOQ	3.4	0.0				1.2		12.9	
QSRatio									
95th Percentile Output:									
fB%	2.3	2.6				2.5		1.8	
BOQ	4.2	0.0				1.6		14.5	
QSRatio									
98th Percentile Output:									
fB%	2.7	3.2				3.0		2.0	
BOQ	5.0	0.0				1.9		16.1	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		444	1		3			24	507	0
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				Thru			
	Right	P				Right			
	Peds					Peds			
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right					Right	P		
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	776	1863	0.00	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	601	1443	0.47	0.42	15.2	B		
LT	577	1386	0.49	0.42	15.7	B	15.5	B

Northbound

L	251	602	0.02	0.42	10.4	B	10.4	B
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Southbound

LTR	2059	4942	0.32	0.42	12.2	B	12.2	B
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Intersection Delay = 13.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		444	1		3			24	507	0
% Heavy Veh	2	2		3	3		1			1	1	1
PHF	0.80	0.25		0.79	0.79		0.80			0.81	0.81	0.81
PK 15 Vol	1	0		141	1		1			7	156	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	1			281	282		4			656		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.996		1.000				0.046	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.981			0.998		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		444	1		3			24	507	0
PHF	0.80	0.25		0.79	0.79		0.80			0.81	0.81	0.81
Adj flow	1	0		562	1		4			30	626	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	1			281	282		4			656		
Prop LTs	0.000			1.000 0.996			1.000			0.046		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.980		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.757 0.727		0.343		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1863		1443 1386		602		4942	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1	1863	0.00	0.42	776	0.00
Right							
Westbound							
Prot							
Perm							
Left	L	281	1443	0.19	0.42	601	0.47
Prot							
Perm							
Thru	LT	282	1386	# 0.20	0.42	577	0.49
Right							
Northbound							
Prot							
Perm							
Left	L	4	602	0.01	0.42	251	0.02
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	656	4942	# 0.13	0.42	2059	0.32
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.34
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.40

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.00	0.42	10.2	1.000	776	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.47	0.42	12.7	1.000	601	0.50	2.6	0.0	15.2	B		
LT	0.49	0.42	12.8	1.000	577	0.50	2.9	0.0	15.7	B	15.5	B
Northbound												
L	0.02	0.42	10.3	1.000	251	0.50	0.1	0.0	10.4	B	10.4	B
Southbound												
LTR	0.32	0.42	11.8	1.000	2059	0.50	0.4	0.0	12.2	B	12.2	B

Intersection delay = 13.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		281	4	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.05	
Adjusted opposing flow rate, Vo (veh/h)		1	656	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		4.68	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.02	4.01	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	3.05	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	21.95	
n=Max(gq-gf)/2,0)		0.00	1.52	
PTHo=1-PLTo		1.00	0.95	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	2.56	
EL2=Max((1-Ptho*n)/Plto, 1.0)			1.50	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	3.05	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.34	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.757	0.343	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	281		
Proportion of LT in LT lane group, PLT	0.000	0.996	0.046
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)	1		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600		4.68	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.02	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.727	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	1		281	282	4		240	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1863		1443	1386	602		1814	
LnCapacity	776		601	577	251		755	
Flow Ratio	0.0		0.2	0.2	0.0		0.1	
v/c Ratio	0.00		0.47	0.49	0.02		0.32	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.981		0.998	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		3.4	3.4	0.0		2.7	
kB	0.7		0.6	0.6	0.3		0.7	
Q2	0.0		0.5	0.5	0.0		0.3	
Q Average	0.0		3.9	4.0	0.0		3.0	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3		1.3	
BOQ	0.0		4.9	5.0	0.1		3.8	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.7		1.6	
BOQ	0.0		6.0	6.1	0.1		4.7	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.7	2.0		1.8	
BOQ	0.0		6.8	6.9	0.1		5.4	
QSRatio								
95th Percentile Output:								
fB%	2.6		2.1	2.1	2.6		2.1	
BOQ	0.0		8.0	8.2	0.1		6.5	
QSRatio								
98th Percentile Output:								
fB%	3.2		2.4	2.4	3.2		2.5	
BOQ	0.0		9.3	9.5	0.1		7.6	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound				Westbound		
		1 L	2 T	3 R		4 L	5 T	6 R

Volume		0						
Peak-Hour Factor, PHF		0.82						
Hourly Flow Rate, HFR		0						
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1						
Configuration		T						
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Northbound				Southbound		
		7 L	8 T	9 R		10 L	11 T	12 R

Volume				204				
Peak Hour Factor, PHF				0.78				
Hourly Flow Rate, HFR				261				
Percent Heavy Vehicles				1				
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/			/
Lanes			1					
Configuration			R					

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

Lane Config					R			
v (vph)					261			
C(m) (vph)					1088			
v/c					0.24			
95% queue length					0.94			
Control Delay					9.3			
LOS					A			
Approach Delay				9.3				
Approach LOS				A				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		0				
Peak-Hour Factor, PHF		0.82				
Peak-15 Minute Volume		0				
Hourly Flow Rate, HFR		0				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			204			
Peak Hour Factor, PHF			0.78			
Peak-15 Minute Volume			65			
Hourly Flow Rate, HFR			261			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					0			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	0	
Potential Capacity	1088	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1088	
Probability of Queue free St.	0.76	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.76
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.76
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			261			
Movement Capacity (vph)			1088			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1088			
Volume			261			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					261			
C(m) (vph)					1088			
v/c					0.24			
95% queue length					0.94			
Control Delay					9.3			
LOS					A			
Approach Delay				9.3				
Approach LOS				A				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	169	21	169	132	0	0	0	0	13	66	28
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.79				0.81 0.81	
Flow Rate	237		380				56 74	
% Heavy Veh	24		5				3 3	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	237		380				56	74
Left-Turn	0		213				16	0
Right-Turn	26		0				0	34
Prop. Left-Turns	0.0		0.6				0.3	0.0
Prop. Right-Turns	0.1		0.0				0.0	0.5
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	175	0	0	242	20	58	53	53	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.79		0.87		0.87	
Flow Rate	225		331		95		91	
% Heavy Veh	17		7		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	225		331		95	91		
Left-Turn	7		0		66	0		
Right-Turn	0		25		0	60		
Prop. Left-Turns	0.0		0.0		0.7	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.2		0.1		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	79	93	57	6	45	1	400	76	1			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	556	1588	0.39	0.35	16.8	B	16.2	B
R	549	1568	0.08	0.35	13.4	B		

Westbound

LTR	546	1559	0.12	0.35	13.7	B	13.7	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2253	4661	0.28	0.48	9.6	A	9.6	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 11.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	79	93	57	6	45	1	400	76	1			
% Heavy Veh	3	3	3	1	1	1	3	3	3			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
PK 15 Vol	25	29	18	2	14	1	132	25	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			21			0			0			
Adj Flow		218	46		66			627				
%InSharedLn												
Prop LTs		0.459			0.121			0.839				
Prop RTs		0.000	1.000		0.015			0.002				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.998			0.978				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	79	93	57	6	45	1	400	76	1			
PHF	0.79	0.79	0.79	0.79	0.79	0.79	0.76	0.76	0.76			
Adj flow	100	118	46	8	57	1	526	100	1			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	218 46			66			627					
Prop LTs	0.459			0.121			0.839					
Prop RTs	0.000 1.000			0.015			0.002					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000	0.983		0.967			
fHV	0.971	0.971	0.990		0.971			
fG	1.000	1.000	1.000		1.000			
fP	1.000	1.000	0.875		1.000			
fBB	1.000	1.000	1.000		1.000			
fA	1.000	1.000	1.000		1.000			
fLU	1.000	1.000	1.000		0.908			
fRT	1.000	0.850	0.998		1.000			
fLT	0.833		0.965		0.960			
Sec.								
fLpb	1.000		1.000		1.000			
fRpb	1.000	1.000	1.000		1.000			
S	1588	1568	1559		4661			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.39	0.35	14.7	1.000	556	0.50	2.1	0.0	16.8	B	16.2	B
R	0.08	0.35	13.1	1.000	549	0.50	0.3	0.0	13.4	B		
Westbound												
LTR	0.12	0.35	13.2	1.000	546	0.50	0.5	0.0	13.7	B	13.7	B
Northbound												
LTR	0.28	0.48	9.3	1.000	2253	0.50	0.3	0.0	9.6	A	9.6	A
Southbound												

Intersection delay = 11.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo	1.000	1.000		0.908
----------------------------------	-------	-------	--	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	100	8	
Proportion of LT in LT lane group, PLT	0.459	0.121	0.839
Proportion of LT in opposing flow, PLTo	0.12	0.46	
Adjusted opposing flow rate, Vo (veh/h)	66	218	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	1.67	0.13	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.10	3.63	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.4	12.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	3.36	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.58	8.94	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.88	0.54	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.46	0.12	
EL1 (refer to Exhibit C16-3)	1.48	1.73	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.833	0.965	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	3.36		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.160		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	66	218	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.459	0.121	0.839	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.015	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				60.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.7	0.00	0.0	0.0	16.8
R	0.0	0.00	19.5	13.1	0.00	0.0	0.0	13.4
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.3	0.00	0.0	0.0	9.6
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			11.7	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		LT	R		LTR			LTR				
Init Queue		0.0	0.0		0.0			0.0				
Flow Rate		218	46		66			230				
So		1900	1900		1900			1900				
No.Lanes	0	1	1	0	1	0	0	3	0	0	0	0
SL		1588	1568		1559			1711				
LnCapacity		556	549		546			827				
Flow Ratio		0.1	0.0		0.0			0.1				
v/c Ratio		0.39	0.08		0.12			0.28				
Grn Ratio		0.35	0.35		0.35			0.48				
I Factor		0.999			0.998			0.978				
AT or PVG		3	3		3			3				
Pltn Ratio		1.00	1.00		1.00			1.00				
PF2		1.00	1.00		1.00			1.00				
Q1		2.7	0.5		0.7			2.3				
kB		0.6	0.6		0.6			0.7				
Q2		0.4	0.1		0.1			0.3				
Q Average		3.1	0.6		0.8			2.6				
Q Spacing		25.0	25.0		25.0			25.0				
Q Storage		0	0		0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.3	1.3		1.3			1.3				
BOQ		3.9	0.7		1.1			3.2				
QSRatio												
85th Percentile Output:												
fB%		1.6	1.7		1.7			1.6				
BOQ		4.8	0.9		1.4			4.1				
QSRatio												
90th Percentile Output:												
fB%		1.8	1.9		1.9			1.8				
BOQ		5.5	1.1		1.6			4.6				
QSRatio												
95th Percentile Output:												
fB%		2.1	2.5		2.4			2.2				
BOQ		6.6	1.4		2.0			5.7				
QSRatio												
98th Percentile Output:												
fB%		2.5	3.0		3.0			2.6				
BOQ		7.8	1.7		2.4			6.7				
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	76		18				16	349		476	36	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	466	1747	0.27	0.27	18.8	B	18.8	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1012	1786	0.41	0.57	8.4	A	8.4	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1100	1941	0.54	0.57	9.7	A	9.7	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 10.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	76		18				16	349		476	36	
% Heavy Veh	1		1				7	7		9	9	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
PK 15 Vol	26		6				4	98		138	10	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		127						410			595	
%InSharedLn												
Prop LTs		0.811						0.044			0.000	
Prop RTs		0.189						0.000			0.071	
Peds Bikes	0			0						0		0
Buses		0						7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.997						0.936			0.808	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	76		18				16	349		476	36	
PHF	0.74		0.74				0.89	0.89		0.86	0.86	
Adj flow	103		24				18	392		553	42	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		127						410			595	
Prop LTs		0.811						0.044			0.000	
Prop RTs	0.189						0.000			0.071		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.935			0.917		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.974						1.000			0.990		
fLT	0.961						0.970			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1747						1786			1941		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	127	1747	# 0.07	0.27	466	0.27
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	410	1786	0.23	0.57	1012	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	595	1941	# 0.31	0.57	1100	0.54
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.38$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.46$

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.27	0.27	17.4	1.000	466	0.50	1.4	0.0	18.8	B	18.8	B
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1012	0.50	1.1	0.0	8.4	A	8.4	A
Southbound												
TR	0.54	0.57	8.1	1.000	1100	0.50	1.5	0.0	9.7	A	9.7	A

Intersection delay = 10.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.811	0.044	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		595	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.92	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.69	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.52	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.970	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.69	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.197	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			595	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.044	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.071
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	17.4	0.00	0.0	0.0 0.0 0.0	18.8
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	7.3	0.00	0.0	0.0 0.0 0.0	8.4
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	8.1	0.00	0.0	0.0 0.0 0.0	9.7
Intersection Delay			10.3	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	127						410			595		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1747						1786			1941		
LnCapacity	466						1012			1100		
Flow Ratio	0.1						0.2			0.3		
v/c Ratio	0.27						0.41			0.54		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.997						0.936			0.808		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	1.7						3.8			6.2		
kB	0.5						0.8			0.7		
Q2	0.2						0.5			0.9		
Q Average	1.9						4.4			7.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.4						5.5			8.6		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.0						6.7			10.4		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.7			1.6		
BOQ	3.4						7.5			11.4		
QSRatio												
95th Percentile Output:												
fB%	2.3						2.0			1.8		
BOQ	4.3						8.9			13.0		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.3			2.1		
BOQ	5.1						10.2			14.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	176		53				30	447		329	233	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								17	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru					Thru	P		
	Right	P				Right			
	Peds	X				Peds			
WB	Left					SB Left			
	Thru					Thru	P		
	Right					Right	P		
	Peds	X				Peds	X		
NB	Right					EB Right			
SB	Right					WB Right			
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	514	1542	0.56	0.33	20.6	C	20.6	C
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	799	1598	0.67	0.50	15.2	B	15.2	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	911	1822	0.70	0.50	15.6	B	15.6	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	176		53				30	447		329	233	
% Heavy Veh	14		14				8	8		11	11	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
PK 15 Vol	55		17				8	126		96	68	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									17
Adj Flow		286						536			634	
%InSharedLn												
Prop LTs		0.769						0.063			0.000	
Prop RTs	0.231						0.000			0.396		
Peds Bikes	0	0		0						0	0	
Buses		0						7			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.982						0.866			0.927	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	176		53				30	447		329	233	
PHF	0.80		0.80				0.89	0.89		0.86	0.86	
Adj flow	220		66				34	502		383	251	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		286						536			634	
Prop LTs		0.769						0.063			0.000	
Prop RTs		0.231						0.000			0.396	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.877						0.926			0.901		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.972			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.969						1.000			0.947		
fLT	0.963						0.942			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1542						1598			1822		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	286	1542	# 0.19	0.33	514	0.56
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	536	1598	0.34	0.50	799	0.67
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	634	1822	# 0.35	0.50	911	0.70
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.53
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.56	0.33	16.4	1.000	514	0.50	4.2	0.0	20.6	C	20.6	C
Westbound												
Northbound												
LT	0.67	0.50	11.3	1.000	799	0.50	3.9	0.0	15.2	B	15.2	B
Southbound												
TR	0.70	0.50	11.5	1.000	911	0.50	4.1	0.0	15.6	B	15.6	B

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		34	
Proportion of LT in LT lane group, PLT	0.769	0.063	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		634	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.57	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.57	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		11.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		9.28	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		18.56	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.06	
EL1 (refer to Exhibit C16-3)		2.62	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.94	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.942	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			9.28	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.309	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		634	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.769		0.063	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.231	0.396
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.4	0.00	0.0	0.0	20.6
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	11.3	0.00	0.0	0.0	15.2
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	11.5	0.00	0.0	0.0	15.6
	0.0						0.0	
Intersection Delay			16.4	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	286						536			634		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1542						1598			1822		
LnCapacity	514						799			911		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.56						0.67			0.70		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.982						0.866			0.927		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	3.9						6.7			8.1		
kB	0.5						0.6			0.7		
Q2	0.6						1.2			1.6		
Q Average	4.6						8.0			9.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.6						9.7			11.8		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.4		
BOQ	6.9						11.6			14.0		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	7.7						12.8			15.3		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.8			1.7		
BOQ	9.1						14.4			17.0		
QSRatio												
98th Percentile Output:												
fB%	2.3						2.0			1.9		
BOQ	10.5						16.0			18.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	3		70	243	393	163	62	199		472	21	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	218	1636	0.02	0.13	22.7	C	29.1	C
R	216	1620	0.41	0.13	29.4	C		
Westbound								
LTR	1314	4638	0.69	0.28	21.3	C	21.3	C
Northbound								
L	120	355	0.57	0.33	34.1	C		
T	575	1726	0.38	0.33	17.1	B	21.2	C
Southbound								
TR	662	1985	0.98	0.33	34.6	C	34.6	C

Intersection Delay = 26.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3		70	243	393	163	62	199		472	21	
% Heavy Veh	3		3	3	3	3	7	7		7	7	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
PK 15 Vol	1		22	69	112	46	17	55		155	7	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		89		908		69	221			649	
%InSharedLn												
Prop LTs					0.304		1.000	0.000			0.000	
Prop RTs			1.000		0.204			0.000			0.043	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	7			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.974			0.725			0.946			0.293	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3		70	243	393	163	62	199		472	21	
PHF	0.79		0.79	0.88	0.88	0.88	0.90	0.90		0.76	0.76	
Adj flow	4		89	276	447	185	69	221		621	28	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		89		908		69	221		649		
Prop LTs					0.304		1.000	0.000		0.000		
Prop RTs			1.000		0.204			0.000		0.043		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.971	0.971	0.971	0.971	0.935	0.935	0.935	0.935
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.972	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.969	0.969		1.000	0.994	0.994
fLT	0.950		0.985	0.985	0.200	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1636	1620	4638	4638	355	1726	1985	1985
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1636	0.00	0.13	218	0.02
Prot							
Perm							
Thru							
Right	R	89	1620	# 0.05	0.13	216	0.41
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	908	4638	# 0.20	0.28	1314	0.69
Right							
Northbound							
Prot							
Perm							
Left	L	69	355	0.19	0.33	120	0.57
Prot							
Perm							
Thru	T	221	1726	0.13	0.33	575	0.38
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	649	1985	# 0.33	0.33	662	0.98
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.58

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.02	0.13	22.6	1.000	218	0.50	0.2	0.0	22.7	C	29.1	C	
R	0.41	0.13	23.8	1.000	216	0.50	5.6	0.0	29.4	C			
Westbound													
LTR	0.69	0.28	19.2	1.000	1314	0.50	2.2	0.0	21.3	C	21.3	C	
Northbound													
L	0.57	0.33	16.5	1.000	120	0.50	17.6	0.0	34.1	C	21.2	C	
T	0.38	0.33	15.3	1.000	575	0.50	1.8	0.0	17.1	B			
Southbound													
TR	0.98	0.33	19.8	1.000	662	0.50	14.8	0.0	34.6	C	34.6	C	

Intersection delay = 26.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			69	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			649	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			1.15	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.82	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			14.73	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.27	
n=Max(gq-gf)/2,0)			7.37	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.39	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.304 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			14.73	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.737	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			649	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.204	0.043
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				60.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	23.8	0.00	0.0	0.0	29.4
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.2	0.00	0.0	0.0	21.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	16.5	0.00	0.0	0.0	34.1
T	0.0	0.00	20.0	15.3	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	19.8	0.00	0.0	0.0	34.6
	0.0						0.0	
Intersection Delay			26.1	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	89		333		69	221		649
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1636	1620		1702		355	1726		1985
LnCapacity	218	216		482		120	575		662
Flow Ratio	0.0	0.1		0.2		0.2	0.1		0.3
v/c Ratio	0.02	0.41		0.69		0.57	0.38		0.98
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.974		0.725			0.946		0.293
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	1.4		4.9		0.9	2.8		10.7
kB	0.3	0.3		0.4		0.2	0.6		0.2
Q2	0.0	0.2		0.8		0.2	0.3		3.2
Q Average	0.1	1.6		5.7		1.2	3.2		13.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.3		1.2		1.3	1.3		1.2
BOQ	0.1	2.0		7.1		1.5	4.0		16.8
QSRatio									
85th Percentile Output:									
fB%	1.7	1.6		1.5		1.6	1.6		1.4
BOQ	0.1	2.5		8.6		1.9	4.9		19.7
QSRatio									
90th Percentile Output:									
fB%	2.0	1.9		1.7		1.9	1.8		1.5
BOQ	0.1	2.9		9.5		2.2	5.6		21.3
QSRatio									
95th Percentile Output:									
fB%	2.6	2.3		1.9		2.4	2.1		1.7
BOQ	0.2	3.6		11.0		2.8	6.7		23.1
QSRatio									
98th Percentile Output:									
fB%	3.2	2.8		2.2		2.9	2.5		1.8
BOQ	0.2	4.4		12.5		3.4	7.9		24.9
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E

Inter.: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	12	39	11				5	249	98	258	495	32
Lane Width	13.0						16.0			12.0	12.0	
RTOR Vol	0						0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 457 1612 0.16 0.28 16.9 B 16.9 B

Westbound

Northbound

LTR 899 1635 0.44 0.55 9.4 A 9.4 A

Southbound

L 517 940 0.62 0.55 12.2 B
 TR 960 1745 0.69 0.55 11.9 B 12.0 B

Intersection Delay = 11.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	12	39	11				5	249	98	258	495	32
% Heavy Veh	3	3	3				7	7	7	7	7	7
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
PK 15 Vol	4	11	3				2	69	27	81	155	10
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		73						392		322	659	
%InSharedLn												
Prop LTS		0.192						0.015		1.000	0.000	
Prop RTS		0.178						0.278			0.061	
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						7		0	2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.941			0.518	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	12	39	11				5	249	98	258	495	32
PHF	0.85	0.85	0.85				0.90	0.90	0.90	0.80	0.80	0.80
Adj flow	14	46	13				6	277	109	322	619	40
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
Lane group	LTR						LTR			L	TR	
Adj flow		73						392		322	659	
Prop LTs		0.192						0.015		1.000	0.000	
Prop RTs	0.178						0.278			0.061		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW	1.033						1.133			1.000	1.000	
fHV	0.971						0.935			0.935	0.935	
fG	1.000						1.000			1.000	1.000	
fP	0.875						0.875			1.000	1.000	
fBB	1.000						0.972			1.000	0.992	
fA	1.000						1.000			1.000	1.000	
fLU	1.000						1.000			1.000	1.000	
fRT	0.976						0.962				0.991	
fLT	0.991						0.992			0.529	1.000	
Sec.												
fLpb	1.000						1.000			1.000	1.000	
fRpb	1.000						1.000				1.000	
S	1612						1635			940	1745	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	73	1612	# 0.05	0.28	457	0.16
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	392	1635	0.24	0.55	899	0.44
Right							
Southbound							
Prot							
Perm							
Left	L	322	940	0.34	0.55	517	0.62
Prot							
Perm							
Thru	TR	659	1745	# 0.38	0.55	960	0.69
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.16	0.28	16.1	1.000	457	0.50	0.7	0.0	16.9	B	16.9	B	
Westbound													
Northbound													
LTR	0.44	0.55	8.0	1.000	899	0.50	1.4	0.0	9.4	A	9.4	A	
Southbound													
L	0.62	0.55	9.2	1.000	517	0.50	2.9	0.0	12.2	B			
TR	0.69	0.55	9.8	1.000	960	0.50	2.1	0.0	11.9	B	12.0	B	

Intersection delay = 11.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				322
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				392
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.37
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				6.53
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				3.85
gu=g-gq if gq>=gf, or = g-gf if gq<gf				29.15
n=Max(gq-gf)/2,0)				1.93
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.89
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.91
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				3.85
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.53
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.529

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.192
Proportion of LT in opposing flow, PLTo	0.015 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	659
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.98
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	8.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.14
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02
EL1 (refer to Exhibit C16-3)	2.69
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.992

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			8.15	3.85
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.247	0.117
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			659	392
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.015	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.178	0.278	0.061
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.1	0.00	0.0	0.0	16.9
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.0	0.00	0.0	0.0	9.4
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.2	0.00	0.0	0.0	12.2
TR	0.0	0.00	13.5	9.8	0.00	0.0	0.0	11.9
	0.0						0.0	

Intersection Delay	11.5	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound					
LaneGroup		LTR								LTR			L	TR	
Init Queue		0.0								0.0			0.0	0.0	
Flow Rate		73								392			322	659	
So		1900								1900			1900	1900	
No.Lanes	0	1	0		0	0	0		0	1	0		1	1	0
SL		1612								1635			940	1745	
LnCapacity		457								899			517	960	
Flow Ratio		0.0								0.2			0.3	0.4	
v/c Ratio		0.16								0.44			0.62	0.69	
Grn Ratio		0.28								0.55			0.55	0.55	
I Factor		1.000								0.941				0.518	
AT or PVG		3								3			3	3	
Pltn Ratio		1.00								1.00			1.00	1.00	
PF2		1.00								1.00			1.00	1.00	
Q1		0.9								3.9			3.7	7.9	
kB		0.5								0.8			0.3	0.4	
Q2		0.1								0.6			0.5	0.9	
Q Average		1.0								4.4			4.1	8.9	
Q Spacing		25.0								25.0			25.0	25.0	
Q Storage		0								0			0	0	
Q S Ratio															
70th Percentile Output:															
fB%		1.3								1.2			1.2	1.2	
BOQ		1.3								5.5			5.1	10.8	
QSRatio															
85th Percentile Output:															
fB%		1.6								1.5			1.5	1.5	
BOQ		1.7								6.8			6.3	12.9	
QSRatio															
90th Percentile Output:															
fB%		1.9								1.7			1.7	1.6	
BOQ		1.9								7.6			7.1	14.1	
QSRatio															
95th Percentile Output:															
fB%		2.4								2.0			2.0	1.8	
BOQ		2.4								8.9			8.4	15.7	
QSRatio															
98th Percentile Output:															
fB%		2.9								2.3			2.4	2.0	
BOQ		2.9								10.3			9.7	17.3	
QSRatio															

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	8	20	13	172	16	104	10	202	131	138	311	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 648 1457 0.09 0.44 14.8 B 14.8 B

Westbound

L 548 1232 0.36 0.44 18.2 B
 T 777 1749 0.02 0.44 14.1 B 17.2 B
 R 574 1291 0.21 0.44 16.1 B

Northbound

LTR 695 1563 0.55 0.44 21.0 C 21.0 C

Southbound

LTR 540 1214 1.12 0.44 80.2 F 80.2 F

Intersection Delay = 45.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	20	13	172	16	104	10	202	131	138	311	9
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	5	49	5	30	3	56	36	45	102	3
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900	1900	1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol			0			0		0				0
Adj Flow	60			195	18	118	381			603		
%InSharedLn												
Prop LTS		0.200		1.000	0.000			0.029			0.302	
Prop RTS	0.317			0.000	1.000		0.383			0.020		
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0	0.0	0.0			0.0		
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000			0.966			0.850			0.090		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5			11.8			18.9			18.3		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		40.0						40.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	20	13	172	16	104	10	202	131	138	311	9
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	12	29	19	195	18	118	11	224	146	182	409	12
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	60			195	18	118	381			603		
Prop LTs	0.200			1.000	0.000		0.029			0.302		
Prop RTs	0.317			0.000 1.000			0.383			0.020		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.971		0.952	0.952	0.952	0.935		0.935		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.957		1.000 0.850			0.948		0.997		
fLT	0.968		0.718	1.000		0.981		0.692		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.991		
fRpb	0.982		1.000 1.000			0.979		1.000		
S	1457		1232	1749	1291	1563		1214		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1457	0.04	0.44	648	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	195	1232	# 0.16	0.44	548	0.36
Prot							
Perm							
Thru	T	18	1749	0.01	0.44	777	0.02
Right	R	118	1291	0.09	0.44	574	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	381	1563	0.24	0.44	695	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1214	# 0.50	0.44	540	1.12
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C	d1						Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	648	0.50	0.3	0.0	14.8	B	14.8	B
Westbound												
L	0.36	0.44	16.5	1.000	548	0.50	1.7	0.0	18.2	B		
T	0.02	0.44	14.0	1.000	777	0.50	0.1	0.0	14.1	B	17.2	B
R	0.21	0.44	15.3	1.000	574	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.55	0.44	18.4	1.000	695	0.50	2.6	0.0	21.0	C	21.0	C
Southbound												
LTR	1.12	0.44	25.0	1.000	540	0.50	55.2	0.0	80.2	F	80.2	F

Intersection delay = 45.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		195		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.20		
Adjusted opposing flow rate, Vo (veh/h)		60		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.80		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.718		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	12	11	182	
Proportion of LT in LT lane group, PLT	0.200	0.000	0.029	0.302
Proportion of LT in opposing flow, PLTo	0.00		0.30	0.03
Adjusted opposing flow rate, Vo (veh/h)	18		603	381
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.30		0.28	4.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45		15.07	9.52
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.6		22.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56		0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00		15.94	9.76
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.43		17.69	30.24
n=Max(gq-gf)/2,0)	0.00		0.00	4.88
PTHo=1-PLTo	1.00		0.70	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.20		0.03	0.30
EL1 (refer to Exhibit C16-3)	1.40		2.54	2.04
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	4.61
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		0.05	0.07
gdifff=max(gq-gf,0)	0.00		0.00	9.76
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97		0.98	0.69
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.968		0.981	0.692

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.94	9.76
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.399	0.244
OCCpedu	0.000	0.056	0.000	0.049
Opposing flow rate, Vo (veh/h)	18	60	603	381
OCCr	0.000	0.052	0.000	0.029
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.971
Proportion of left turns, PLT	0.200	1.000	0.029	0.302
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.991

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.317	1.000	0.383	0.020
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.979	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	14.5	0.00	0.0	0.0 0.0 0.0	14.8
Westbound								
L	0.0	0.00	25.0	16.5	0.00	0.0	0.0	18.2
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
LTR	0.0 0.0 0.0	0.00	25.0	18.4	0.00	0.0	0.0 0.0 0.0	21.0
Southbound								
LTR	0.0 0.0 0.0	0.00	25.0	25.0	0.00	15.8	0.0 0.0 0.0	80.2

Intersection Delay	45.8	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	60			195	18	118	381			603		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1457			1232	1749	1291	1563			1214		
LnCapacity	648			548	777	574	695			540		
Flow Ratio	0.0			0.2	0.0	0.1	0.2			0.5		
v/c Ratio	0.09			0.36	0.02	0.21	0.55			1.12		
Grn Ratio	0.44			0.44	0.44	0.44	0.44			0.44		
I Factor	1.000			0.966			0.850			0.090		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.9			3.2	0.3	1.8	7.0			15.1		
kB	0.8			0.7	0.9	0.7	0.8			0.1		
Q2	0.1			0.4	0.0	0.2	0.9			8.5		
Q Average	1.0			3.6	0.3	2.0	7.9			23.5		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	1.2			4.5	0.4	2.5	9.6			28.3		
QSRatio												
85th Percentile Output:												
fB%	1.6			1.5	1.7	1.6	1.5			1.4		
BOQ	1.6			5.6	0.5	3.2	11.5			33.0		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.7	2.0	1.8	1.6			1.5		
BOQ	1.8			6.3	0.5	3.7	12.6			35.4		
QSRatio												
95th Percentile Output:												
fB%	2.4			2.1	2.5	2.3	1.8			1.6		
BOQ	2.3			7.5	0.7	4.5	14.3			37.9		
QSRatio												
98th Percentile Output:												
fB%	2.9			2.4	3.1	2.7	2.0			1.7		
BOQ	2.8			8.8	0.9	5.4	15.9			40.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	175	188		186	217		281		159			
Lane Width	16.0			16.0			11.0					
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	901	1801	0.39	0.50	15.1	B	15.1	B
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Westbound

LT	551	1102	0.82	0.50	31.9	C	31.9	C
----	-----	------	------	------	------	---	------	---

Northbound

LR	529	1359	0.88	0.39	42.5	D	42.5	D
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Southbound

Intersection Delay = 31.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		175	188	186	217		281		159			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		48	51	52	61		75		42			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		347			453			468				
%InSharedLn												
Prop LTs		0.000			0.461			0.639				
Prop RTs		0.452			0.000			0.361				
Peds Bikes	0						0			0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		175	188	186	217		281		159			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		190	157	209	244		299		169			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		347			453			468				
Prop LTs		0.000			0.461			0.639				
Prop RTs		0.452			0.000			0.361				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.909			0.885			0.917					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.939			1.000			0.951					
fLT	1.000			0.578			0.969					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1801			1102			1359					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.39	0.50	13.9	1.000	901	0.50	1.2	0.0	15.1	B	15.1	B
Westbound												
LT	0.82	0.50	19.1	1.000	551	0.50	12.8	0.0	31.9	C	31.9	C
Northbound												
LR	0.88	0.39	25.6	1.000	529	0.50	16.9	0.0	42.5	D	42.5	D
Southbound												

Intersection delay = 31.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	209		
Proportion of LT in LT lane group, PLT	0.000	0.461	0.639
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	347		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.22		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	7.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	37.71		
n=Max(gq-gf)/2,0)	3.65		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.46		
EL1 (refer to Exhibit C16-3)	1.97		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.58		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.578		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	19.1	0.00	0.0	0.0	31.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.6	0.00	0.0	0.0	42.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			31.2	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		347			453			468				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1801			1102			1359				
LnCapacity		901			551			529				
Flow Ratio		0.2			0.4			0.3				
v/c Ratio		0.39			0.82			0.88				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.964			0.986			0.858				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		5.4			9.6			10.9				
kB		1.0			0.7			0.6				
Q2		0.6			2.8			3.3				
Q Average		6.0			12.4			14.2				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		7.4			15.0			17.2				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.4				
BOQ		9.0			17.7			20.2				
QSRatio												
90th Percentile Output:												
fB%		1.7			1.5			1.5				
BOQ		9.9			19.1			21.8				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.7			1.7				
BOQ		11.4			20.9			23.6				
QSRatio												
98th Percentile Output:												
fB%		2.2			1.8			1.8				
BOQ		12.9			22.6			25.5				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrotts Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	24	17	39	38	19	25	36	259	43	32	283	23
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 229 1963 0.45 0.12 31.0 C 31.0 C

Westbound

LTR 459 1836 0.20 0.25 18.8 B 18.8 B

Northbound

LTR 692 1804 0.58 0.38 18.1 B 18.1 B

Southbound

LTR 642 1676 0.58 0.38 18.4 B 18.4 B

Intersection Delay = 19.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	24	17	39	38	19	25	36	259	43	32	283	23
% Heavy Veh	1	1	1	10	10	10	8	8	8	18	18	18
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
PK 15 Vol	8	5	13	11	5	7	11	76	13	9	78	6
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		103			93			398			371	
%InSharedLn												
Prop LTs		0.301			0.462			0.106			0.094	
Prop RTs		0.485			0.301			0.128			0.067	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			3			3	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	24	17	39	38	19	25	36	259	43	32	283	23
PHF	0.78	0.78	0.78	0.88	0.88	0.88	0.85	0.85	0.85	0.91	0.91	0.91
Adj flow	31	22	50	43	22	28	42	305	51	35	311	25
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	103			93			398			371		
Prop LTs	0.301			0.462			0.106			0.094		
Prop RTs	0.485			0.301			0.128			0.067		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.990			0.909			0.926			0.847		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.988			0.988		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.934			0.959			0.983			0.991		
fLT	0.985			0.977			0.932			0.938		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1963			1836			1804			1676		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	103	1963	# 0.05	0.12	229	0.45
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	93	1836	# 0.05	0.25	459	0.20
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	398	1804	0.22	0.38	692	0.58
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	371	1676	# 0.22	0.38	642	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.32
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.43

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.45	0.12	24.7	1.000	229	0.50	6.3	0.0	31.0	C	31.0	C
Westbound												
LTR	0.20	0.25	17.8	1.000	459	0.50	1.0	0.0	18.8	B	18.8	B
Northbound												
LTR	0.58	0.38	14.6	1.000	692	0.50	3.5	0.0	18.1	B	18.1	B
Southbound												
LTR	0.58	0.38	14.7	1.000	642	0.50	3.8	0.0	18.4	B	18.4	B

Intersection delay = 19.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			42	35
Proportion of LT in LT lane group, PLT	0.301	0.462	0.106	0.094
Proportion of LT in opposing flow, PLTo			0.09	0.11
Adjusted opposing flow rate, Vo (veh/h)			371	398
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.70	0.58
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			6.18	6.63
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			6.6	7.5
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			6.86	7.51
gu=g-gq if gq>=gf, or = g-gf if gq<gf			16.14	15.49
n=Max(gq-gf)/2,0)			0.15	0.03
PTHo=1-PLTo			0.91	0.89
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.11	0.09
EL1 (refer to Exhibit C16-3)			2.02	2.08
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.10	0.10
gdifff=max(gq-gf,0)			0.29	0.05
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.93	0.94
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.932	0.938

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.51
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.327
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				398
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.094
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.485	0.128
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.7	0.00	0.0	0.0	31.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	17.8	0.00	0.0	0.0	18.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.6	0.00	0.0	0.0	18.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.7	0.00	0.0	0.0	18.4
	0.0						0.0	
Intersection Delay			19.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	103		93		398		371	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0	0 1 0	0	0 1 0	0	0 1 0	
SL	1963		1836		1804		1676	
LnCapacity	229		459		692		642	
Flow Ratio	0.1		0.1		0.2		0.2	
v/c Ratio	0.45		0.20		0.58		0.58	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.6		1.2		5.2		4.9	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.1		0.9		0.8	
Q Average	1.8		1.4		6.1		5.7	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.3		1.7		7.5		7.1	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	3.0		2.2		9.1		8.6	
QSRatio								
90th Percentile Output:								
fB%	1.8		1.9		1.6		1.7	
BOQ	3.4		2.5		10.1		9.5	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.4		1.9		1.9	
BOQ	4.2		3.2		11.6		11.0	
QSRatio								
98th Percentile Output:								
fB%	2.7		2.8		2.1		2.2	
BOQ	5.1		3.8		13.1		12.5	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume		315	29			28	331	
Peak-Hour Factor, PHF		0.85	0.85			0.91	0.91	
Hourly Flow Rate, HFR		370	34			30	363	
Percent Heavy Vehicles		--	--			15	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes		1	0			0	1	
Configuration		TR				LT		
Upstream Signal?		No				No		
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		54		24				
Peak Hour Factor, PHF		0.94		0.94				
Hourly Flow Rate, HFR		57		25				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration		LR						

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1	4		7	8	9		10	11	12
Lane Config		LT			LR					
v (vph)		30			82					
C(m) (vph)		1088			401					
v/c		0.03			0.20					
95% queue length		0.09			0.76					
Control Delay		8.4			16.3					
LOS		A			C					
Approach Delay					16.3					
Approach LOS					C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		315	29	28	331	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		93	9	8	91	
Hourly Flow Rate, HFR		370	34	30	363	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	54		24			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	14		6			
Hourly Flow Rate, HFR	57		25			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		363
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		404	810		387			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	387	
Potential Capacity	665	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	665	
Probability of Queue free St.	0.96	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	404	
Potential Capacity	1088	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1088	
Probability of Queue free St.	0.97	1.00
Maj L-Shared Prob Q free St.	0.96	

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	810	
Potential Capacity	352	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.94
Movement Capacity	342	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.96 0.96
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 810
Potential Capacity 352
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.96
Maj. L, Min T Adj. Imp Factor. 0.97
Cap. Adj. factor due to Impeding mvmnt 0.97 0.94
Movement Capacity 342

Results for Two-stage process:

a
y
C t 342

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	57		25			
Movement Capacity (vph)	342		665			
Shared Lane Capacity (vph)		401				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	342		665			
Volume	57		25			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		401				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		30		82				
C(m) (vph)		1088		401				
v/c		0.03		0.20				
95% queue length		0.09		0.76				
Control Delay		8.4		16.3				
LOS		A		C				
Approach Delay				16.3				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.97
v(il), Volume for stream 2 or 5		363
v(i2), Volume for stream 3 or 6		0
s(il), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.96
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.3

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	299	24	496	1	160	300	249	199	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	712	1710	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	521	1250	0.69	0.42	20.8	C	52.3	D
R	518	1244	1.06	0.42	72.8	E		

Northbound

LTR	707	1696	0.71	0.42	20.0+	C	20.0+	C
-----	-----	------	------	------	-------	---	-------	---

Southbound

LTR	407	976	1.28	0.42	162.3	F	162.3	F
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Intersection Delay = 72.7 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Conditions
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	299	24	496	1	160	300	249	199	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	83	7	138	1	43	82	72	58	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			359	551		501			522	
%InSharedLn												
Prop LTs		0.036			0.925			0.002			0.556	
Prop RTs		0.250			0.000	1.000		0.651			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	299	24	496	1	160	300	249	199	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	332	27	551	1	174	326	290	231	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			359 551			501			522		
Prop LTs	0.036			0.925			0.002			0.556		
Prop RTs	0.250			0.000 1.000			0.651			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.912			1.000		
fLT	0.992			0.722			0.999			0.493		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1710			1250 1244			1696			976		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1710	0.02	0.42	712	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	359	1250	0.29	0.42	521	0.69
Right	R	551	1244	# 0.44	0.42	518	1.06
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	501	1696	0.30	0.42	707	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	522	976	# 0.53	0.42	407	1.28
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.98
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.17

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.04	0.42	10.4	1.000	712	0.50	0.1	0.0	10.5	B	10.5	B
Westbound												
LT	0.69	0.42	14.3	1.000	521	0.50	6.5	0.0	20.8	C	52.3	D
R	1.06	0.42	17.5	1.000	518	0.50	55.3	0.0	72.8	E		
Northbound												
LTR	0.71	0.42	14.5	1.000	707	0.50	5.5	0.0	20.0+	C	20.0+	C
Southbound												
LTR	1.28	0.42	17.5	1.000	407	0.50	144.8	0.0	162.3	F	162.3	F

Intersection delay = 72.7 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	332	1	290
Proportion of LT in LT lane group, PLT	0.036	0.925	0.002	0.556
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.56	0.00
Adjusted opposing flow rate, Vo (veh/h)	359	28	522	501
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.53	0.02	4.83
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.98	0.47	8.70	8.35
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.91	0.00	9.51	9.06
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	15.94
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.53
PTHo=1-PLTo	0.08	0.96	0.44	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	0.56
EL1 (refer to Exhibit C16-3)	2.00	1.42	2.35	2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.51
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	9.06
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.722	0.999	0.493

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.91		9.51	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.236		0.380	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	359		522	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.3	0.00	0.0	0.0	20.8
R	0.0	0.00	17.5	17.5	0.00	8.2	0.0	72.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.5	0.00	0.0	0.0	20.0+
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	28.8	0.0	162.3
	0.0						0.0	
Intersection Delay			72.7	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	28			359	551	501		522	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1710			1250	1244	1696		976	
LnCapacity	712			521	518	707		407	
Flow Ratio	0.0			0.3	0.4	0.3		0.5	
v/c Ratio	0.04			0.69	1.06	0.71		1.28	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.887		0.931		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.3			4.9	9.2	6.9		8.7	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			1.0	8.2	1.4		16.2	
Q Average	0.3			5.9	17.4	8.4		24.9	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.4			7.3	20.9	10.2		29.9	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.5	1.4	1.5		1.4	
BOQ	0.5			8.8	24.5	12.2		34.9	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.7	1.5	1.6		1.5	
BOQ	0.6			9.8	26.3	13.3		37.5	
QSRatio									
95th Percentile Output:									
fB%	2.5			1.9	1.6	1.8		1.6	
BOQ	0.8			11.3	28.3	14.9		40.0	
QSRatio									
98th Percentile Output:									
fB%	3.1			2.2	1.7	2.0		1.7	
BOQ	0.9			12.8	30.3	16.6		42.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: Philip Habib & Associates Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				324		3		457			504	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru P			
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru P			
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green		20.0				30.0		
Yellow		3.0				3.0		
All Red		2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 644 1933 0.58 0.33 19.7 B 19.7 B

Northbound

T 970 1940 0.51 0.50 11.7 B 11.7 B

Southbound

T 946 1892 0.62 0.50 12.6 B 12.6 B

Intersection Delay = 14.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: Philip Habib & Associates
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				324		3	457			504		
% Heavy Veh				6		6	11			12		
PHF				0.88		0.88	0.92			0.86		
PK 15 Vol				92		1	124			147		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					371		497			586		
%InSharedLn												
Prop LTs					0.992		0.000			0.000		
Prop RTs					0.008		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			4		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.858			0.858			0.567		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				324		3	457			504		
PHF				0.88		0.88	0.92			0.86		
Adj flow				368		3	497			586		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					371			497			586	
Prop LTs					0.992			0.000			0.000	
Prop RTs					0.008			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.943			0.901			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.984	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1933			1940			1892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	371	1933	# 0.19	0.33	644	0.58
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	497	1940	0.26	0.50	970	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	586	1892	# 0.31	0.50	946	0.62
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.60

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.58	0.33	16.5	1.000	644	0.50	3.2	0.0	19.7	B	19.7	B
Northbound												
T	0.51	0.50	10.1	1.000	970	0.50	1.7	0.0	11.7	B	11.7	B
Southbound												
T	0.62	0.50	10.9	1.000	946	0.50	1.7	0.0	12.6	B	12.6	B

Intersection delay = 14.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.992 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

-----BACK OF QUEUE WORKSHEET-----

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 457 240 146 683
 Peak-Hour Factor, PHF 0.92 0.92 0.86 0.86
 Peak-15 Minute Volume 124 65 42 199
 Hourly Flow Rate, HFR 496 260 169 794
 Percent Heavy Vehicles -- -- 16 -- --
 Median Type/Storage Undivided /
 RT Channelized? No
 Lanes 1 1 1 1
 Configuration T R L T
 Upstream Signal? No No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		16						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		16						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		756						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	756	
Potential Capacity	795	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	795	
Probability of Queue free St.	0.79	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.79	0.79
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Shared Lane Capacity (vph)

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L						
v (vph)		169						
C(m) (vph)		795						
v/c		0.21						
95% queue length		0.80						
Control Delay		10.7						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.79
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		10.7
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				101		207		478	79	194	471	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
WB Left	P				SB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	16.0					34.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 385 1444 0.92 0.27 49.7 D 49.7 D

Northbound

TR 1059 1868 0.57 0.57 10.3 B 10.3 B

Southbound

LT 604 1066 1.28 0.57 146.1 F 146.1 F

Intersection Delay = 79.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				101		207	478	79		194	471	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				29		59	130	21		56	137	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					354			606			774	
%InSharedLn												
Prop LTs					0.328			0.000			0.292	
Prop RTs					0.672			0.142			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.944			0.880			0.500		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				101		207	478	79		194	471	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				116		238	520	86		226	548	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					354			606			774	
Prop LTs					0.328			0.000			0.292	
Prop RTs					0.672			0.142			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.971			0.926			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.984	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.909			0.981			1.000	
fLT					0.984			1.000			0.549	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1444			1868			1066	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	354	1444	# 0.25	0.27	385	0.92
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	606	1868	0.32	0.57	1059	0.57
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	774	1066	# 0.73	0.57	604	1.28
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.97

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.17

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.92	0.27	21.4	1.000	385	0.50	28.3	0.0	49.7	D	49.7	D
Northbound												
TR	0.57	0.57	8.3	1.000	1059	0.50	2.0	0.0	10.3	B	10.3	B
Southbound												
LT	1.28	0.57	13.0	1.000	604	0.50	133.1	0.0	146.1	F	146.1	F

Intersection delay = 79.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			226
Proportion of LT in LT lane group, PLT	0.328	0.000	0.292
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			606
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.77
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			6.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf			27.14
n=Max(gq-gf)/2,0)			3.43
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.29
EL1 (refer to Exhibit C16-3)			2.55
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.08
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.55
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.549

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.202
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				606
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.292
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCChicg	0.020	0.020
OCcr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.672	0.142
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.4	0.00	0.0	0.0	49.7
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	42.5	0.0	146.1
	0.0						0.0	
Intersection Delay			79.0	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR		LT
Init Queue					0.0		0.0		0.0
Flow Rate					354		606		774
So					1900		1900		1900
No.Lanes	0	0	0	0	0	0	1	0	1
SL					1444		1868		1066
LnCapacity					385		1059		604
Flow Ratio					0.2		0.3		0.7
v/c Ratio					0.92		0.57		1.28
Grn Ratio					0.27		0.57		0.57
I Factor					0.944		0.880		0.500
AT or PVG					3		3		3
Pltn Ratio					1.00		1.00		1.00
PF2					1.00		1.00		1.00
Q1					5.7		6.5		12.9
kB					0.4		0.8		0.3
Q2					2.8		1.0		22.5
Q Average					8.5		7.5		35.4
Q Spacing					25.0		25.0		25.0
Q Storage					0		0		0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2		1.2
BOQ					10.4		9.2		42.5
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5		1.4
BOQ					12.4		11.0		49.6
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6		1.5
BOQ					13.5		12.1		53.2
QSRatio									
95th Percentile Output:									
fB%					1.8		1.8		1.6
BOQ					15.2		13.7		56.7
QSRatio									
98th Percentile Output:									
fB%					2.0		2.0		1.7
BOQ					16.8		15.3		60.3
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	144	67	92	39	178	73	106	604	136	122	483	70
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			14		

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	420	1219	0.84	0.34	39.5	D	39.5	D
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	549	1593	0.57	0.34	28.4	C	28.4	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	305	560	0.38	0.54	14.4	B		
TR	1052	1932	0.77	0.54	20.2	C	19.5	B

Southbound

LTR	867	1593	0.86	0.54	27.9	C	27.9	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 26.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Richmond Valley Rd & Page Ave
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	144	67	92	39	178	73	106	604	136	122	483	70
% Heavy Veh	3	3	3	2	2	2	2	2	2	6	6	6
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
PK 15 Vol	42	19	27	11	48	20	29	166	37	34	136	20
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			14
Adj Flow		352			314		116	813			743	
%InSharedLn												
Prop LTs		0.474			0.134		1.000	0.000			0.184	
Prop RTs		0.304			0.252			0.183			0.085	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.649			1.000			0.732			0.973	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	144	67	92	39	178	73	106	604	136	122	483	70
PHF	0.86	0.86	0.86	0.92	0.92	0.92	0.91	0.91	0.91	0.89	0.89	0.89
Adj flow	167	78	107	42	193	79	116	664	149	137	543	63
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	352			314			116 813			743		
Prop LTs	0.474			0.134			1.000 0.000			0.184		
Prop RTs	0.304			0.252			0.183			0.085		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.971			0.980			0.980 0.980			0.943		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.959			0.966			0.973			0.987		
fLT	0.608			0.920			0.322 1.000			0.531		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1219			1593			560 1932			1593		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	352	1219	# 0.29	0.34	420	0.84
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	314	1593	0.20	0.34	549	0.57
Right							
Northbound							
Prot							
Perm							
Left	L	116	560	0.21	0.54	305	0.38
Prot							
Perm							
Thru	TR	813	1932	0.42	0.54	1052	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	743	1593	# 0.47	0.54	867	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.84	0.34	27.2	1.000	420	0.50	12.3	0.0	39.5	D	39.5	D	
Westbound													
LTR	0.57	0.34	24.1	1.000	549	0.50	4.3	0.0	28.4	C	28.4	C	
Northbound													
L	0.38	0.54	11.8	1.000	305	0.50	2.6	0.0	14.4	B			
TR	0.77	0.54	16.1	1.000	1052	0.50	4.1	0.0	20.2	C	19.5	B	
Southbound													
LTR	0.86	0.54	17.5	1.000	867	0.50	10.4	0.0	27.9	C	27.9	C	

Intersection delay = 26.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			116	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.18	
Adjusted opposing flow rate, Vo (veh/h)			743	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			2.90	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.76	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			6.35	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			42.65	
n=Max(gq-gf)/2,0)			3.17	
PTHo=1-PLTo			0.82	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.70	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.58	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			6.35	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.32	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.322	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	167	42	137
Proportion of LT in LT lane group, PLT	0.474	0.134	0.000
Proportion of LT in opposing flow, PLTo	0.13	0.47	0.00
Adjusted opposing flow rate, Vo (veh/h)	314	352	813
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	4.18	1.05	3.43
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.85	8.80	20.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	0.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	10.18	11.56	28.77
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.82	19.44	20.23
n=Max(gq-gf)/2,0)	5.09	1.90	13.98
PTHo=1-PLTo	0.87	0.53	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.47	0.13	0.97
EL1 (refer to Exhibit C16-3)	1.91	1.98	3.12
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.88	1.49	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.07	0.08
gdifff=max(gq-gf,0)	10.18	3.79	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.61	0.92	0.15
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.608	0.920	0.531

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	10.18	11.56	6.35	28.77
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.328	0.373	0.130	0.587
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	314	352	743	813
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.474	0.134	1.000	0.184
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.304	0.252	0.183	0.085
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	27.2	0.00	0.0	0.0	39.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	24.1	0.00	0.0	0.0	28.4
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	11.8	0.00	0.0	0.0	14.4
TR	0.0	0.00	20.5	16.1	0.00	0.0	0.0	20.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	17.5	0.00	0.0	0.0	27.9
	0.0						0.0	
Intersection Delay			26.4	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	352		314		116	813	390	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0	0 1 0	0	1 1 0	0	0 2 0	0
SL	1219		1593		560	1932	836	
LnCapacity	420		549		305	1052	455	
Flow Ratio	0.3		0.2		0.2	0.4	0.5	
v/c Ratio	0.84		0.57		0.38	0.77	0.86	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.649		1.000			0.732	0.973	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	8.1		6.4		1.7	16.0	8.3	
kB	0.4		0.8		0.4	0.9	0.6	
Q2	1.7		1.0		0.2	2.7	2.8	
Q Average	9.8		7.4		1.9	18.7	11.2	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	12.0		9.0		2.4	22.5	13.5	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.5		1.6	1.4	1.4	
BOQ	14.2		10.8		3.0	26.3	16.0	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.8	1.5	1.6	
BOQ	15.5		11.9		3.5	28.3	17.4	
QSRatio								
95th Percentile Output:								
fB%	1.7		1.8		2.3	1.6	1.7	
BOQ	17.1		13.5		4.3	30.3	19.1	
QSRatio								
98th Percentile Output:								
fB%	1.9		2.0		2.7	1.7	1.9	
BOQ	18.8		15.1		5.1	32.4	20.8	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	297						821			585		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound L	662	1986	0.51	0.33	26.9	C	26.9	C

Westbound

Northbound

T 2134 3842 0.42 0.56 12.1 B 12.1 B

Southbound

T 1951 3512 0.34 0.56 11.4 B 11.4 B

Intersection Delay = 14.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	297						821			585		
% Heavy Veh	3						2			3		
PHF	0.88						0.91			0.89		
PK 15 Vol	84						226			164		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	338						902			657		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.738			0.973		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	297						821			585		
PHF	0.88						0.91			0.89		
Adj flow	338						902			657		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	338						902			657		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	
fW	1.133						1.083			1.000		
fHV	0.971						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	1986						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	338	1986	# 0.17	0.33	662	0.51
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	902	3842	# 0.23	0.56	2134	0.42
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	657	3512	0.19	0.56	1951	0.34
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.40$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.46$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.51	0.33	24.1	1.000	662	0.50	2.8	0.0	26.9	C	26.9	C	
Westbound													
Northbound													
T	0.42	0.56	11.6	1.000	2134	0.50	0.5	0.0	12.1	B	12.1	B	
Southbound													
T	0.34	0.56	10.9	1.000	1951	0.50	0.5	0.0	11.4	B	11.4	B	

Intersection delay = 14.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	24.1	0.00	0.0	0.0	26.9
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.6	0.00	0.0	0.0	12.1
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	10.9	0.00	0.0	0.0	11.4
	0.0						0.0	
Intersection Delay			14.5	sec/veh	Intersection LOS			B

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	338						473		345	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	1986						2017		1844	
LnCapacity	662						1120		1024	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.51						0.42		0.34	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.738		0.973	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	6.8						6.9		4.7	
kB	0.9						0.9		1.1	
Q2	0.9						0.7		0.6	
Q Average	7.7						7.5		5.3	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	9.4						9.2		6.5	
QSRatio										
85th Percentile Output:										
fB%	1.5						1.5		1.5	
BOQ	11.2						11.0		8.0	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.7	
BOQ	12.3						12.1		8.8	
QSRatio										
95th Percentile Output:										
fB%	1.8						1.8		1.9	
BOQ	13.9						13.7		10.3	
QSRatio										
98th Percentile Output:										
fB%	2.0						2.0		2.2	
BOQ	15.5						15.3		11.7	
QSRatio										

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		

Volume						585		
Peak-Hour Factor, PHF						0.89		
Hourly Flow Rate, HFR						657		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Raised curb / 1						
RT Channelized?								
Lanes						2		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		

Volume						90		
Peak Hour Factor, PHF						0.84		
Hourly Flow Rate, HFR						107		
Percent Heavy Vehicles						29		
Percent Grade (%)		0				0		
Flared Approach: Exists?/Storage					/		/	
Lanes						1		
Configuration						R		

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound				Eastbound			
Movement	1	4	7	8	9	10	11	12		
Lane Config								R		

v (vph)								107	
C(m) (vph)								655	
v/c								0.16	
95% queue length								0.58	
Control Delay								11.6	
LOS								B	
Approach Delay							11.6		
Approach LOS							B		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 585
 Peak-Hour Factor, PHF 0.89
 Peak-15 Minute Volume 164
 Hourly Flow Rate, HFR 657
 Percent Heavy Vehicles -- --
 Median Type/Storage Raised curb / 1
 RT Channelized?
 Lanes 2
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 90
 Peak Hour Factor, PHF 0.84
 Peak-15 Minute Volume 27
 Hourly Flow Rate, HFR 107
 Percent Heavy Vehicles 29
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized? No
 Lanes 1
 Configuration R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								29
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.5
2-stage								6.5
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								29
t(f)								3.6

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								328
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		328
Potential Capacity		655
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		655
Probability of Queue free St.	1.00	0.84
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	465
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	465
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	465	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	465	900

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	519
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	519

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.84	1.00
Movement Capacity		

Worksheet 8-Shared Lane Calculations

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						655
Volume						107
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12 R
Lane Config								
v (vph)								107
C(m) (vph)								655
v/c								0.16
95% queue length								0.58
Control Delay								11.6
LOS								B
Approach Delay							11.6	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	149	349	152	215	693	84	163	326	223	149	67	89
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	103	308	1.72	0.33	385.8	F		
TR	603	1809	0.93	0.33	48.8	D	130.0	F
Westbound								
L	80	223	2.99	0.33	954.7	F		
TR	1122	3365	0.76	0.33	31.2	C	234.1	F
Northbound								
LTR	926	3332	0.83	0.28	38.9	D	38.9	D
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	353	1590	0.55	0.22	37.1	D	36.0	D

Intersection Delay = 132.6 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	349	152	215	693	84	163	326	223	149	67	89
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	104	45	60	193	23	44	88	60	47	21	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	177	558		239	849			766		186	195	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.228			0.000	
Prop RTs		0.256			0.093			0.313			0.569	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	349	152	215	693	84	163	326	223	149	67	89
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	177	415	143	239	770	79	175	351	240	186	84	111
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	177	558		239	849		766			186	195	
Prop LTs	1.000	0.000		1.000	0.000		0.228			0.000		
Prop RTs	0.256			0.093			0.313			0.569		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.943	0.943		0.962			0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.962			0.986		0.953				0.915	
fLT	0.169	1.000		0.133	1.000		0.989			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	308	1809		223	3365		3332			1711	1590	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	177	308	0.57	0.33	103	1.72
Prot							
Perm							
Thru	TR	558	1809	0.31	0.33	603	0.93
Right							
Westbound							
Prot							
Perm							
Left	L	239	223	# 1.07	0.33	80	2.99
Prot							
Perm							
Thru	TR	849	3365	0.25	0.33	1122	0.76
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	766	3332	# 0.23	0.28	926	0.83
Right							
Southbound							
Prot							
Perm							
Left	L	186	1711	0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	195	1590	# 0.12	0.22	353	0.55
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.42$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.71$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.72	0.33	30.0	1.000	103	0.50	355.8	0.0	385.8	F		
TR	0.93	0.33	28.9	1.000	603	0.50	19.9	0.0	48.8	D	130.0	F
Westbound												
L	2.99	0.33	30.0	1.000	80	0.50	924.7	0.0	954.7	F		
TR	0.76	0.33	26.7	1.000	1122	0.50	4.4	0.0	31.2	C	234.1	F
Northbound												
LTR	0.83	0.28	30.5	1.000	926	0.50	8.4	0.0	38.9	D	38.9	D
Southbound												
L	0.49	0.22	30.5	1.000	380	0.50	4.4	0.0	34.9	C		
TR	0.55	0.22	31.0	1.000	353	0.50	6.0	0.0	37.1	D	36.0	D

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.228 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	14.76			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.492			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	849			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.093
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	18.5	0.0	385.8
TR	0.0	0.00	30.0	28.9	0.00	0.0	0.0	48.8
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	39.8	0.0	954.7
TR	0.0	0.00	30.0	26.7	0.00	0.0	0.0	31.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	30.5	0.00	0.0	0.0	38.9
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	31.0	0.00	0.0	0.0	37.1
	0.0						0.0	

Intersection Delay	132.6	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	177	558		239	445		402			186	195	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	308	1809		223	1767		1749			1711	1590	
LnCapacity	103	603		80	589		486			380	353	
Flow Ratio	0.6	0.3		1.1	0.3		0.2			0.1	0.1	
v/c Ratio	1.72	0.93		2.99	0.76		0.83			0.49	0.55	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.4	13.4		6.0	9.9		9.4			4.1	4.3	
kB	0.2	0.7		0.2	0.7		0.7			0.6	0.5	
Q2	9.7	4.7		20.1	2.0		2.6			0.5	0.6	
Q Average	14.1	18.1		26.1	11.9		12.1			4.6	5.0	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	17.0	21.8		31.3	14.4		14.6			5.7	6.1	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.4			1.5	1.5	
BOQ	20.0	25.5		36.6	17.0		17.2			7.0	7.5	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.5	1.5		1.5			1.7	1.7	
BOQ	21.6	27.4		39.2	18.5		18.6			7.8	8.4	
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.6	1.7		1.7			2.0	2.0	
BOQ	23.4	29.5		41.9	20.2		20.4			9.2	9.8	
QSRatio												
98th Percentile Output:												
fB%	1.8	1.7		1.7	1.8		1.8			2.3	2.3	
BOQ	25.3	31.5		44.6	21.9		22.1			10.6	11.2	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						434		
Peak-Hour Factor, PHF						0.87		
Hourly Flow Rate, HFR						498		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		133						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		143						
Percent Heavy Vehicles		4						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			143						
C(m) (vph)			528						
v/c			0.27						
95% queue length			1.09						
Control Delay			14.3						
LOS			B						
Approach Delay				14.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 434
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 125
 Hourly Flow Rate, HFR 498
 Percent Heavy Vehicles -- -- -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 133
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 36
 Hourly Flow Rate, HFR 143
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			498					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	498	
Potential Capacity	528	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	528	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 498
Potential Capacity 528
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 528

Results for Two-stage process:
a
y
C t 528

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	143					
Movement Capacity (vph)	528					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	528					
Volume	143					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			143					
C(m) (vph)			528					
v/c			0.27					
95% queue length			1.09					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	15	128	60	130	149	172	44	41	41	78	188	58
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.88	0.88	0.90	0.90	0.78	0.78	1.00	1.00
Flow Rate	89	140	226	274	108	52	172	152
% Heavy Veh	42	42	4	4	3	3	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	89	140	226	274	108	52	172	152
Left-Turn	17	0	144	0	56	0	78	0
Right-Turn	0	68	0	191	0	52	0	58
Prop. Left-Turns	0.2	0.0	0.6	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.5	0.0	0.7	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7	-0.7	-0.7	-0.7
hHV-adj	1.7	1.7	1.7	1.7
hadj, computed	0.8	0.4	0.4	-0.4
	0.3	-0.6	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	89	140	226	274	108	52	172	152
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.08	0.12	0.20	0.24	0.10	0.05	0.15	0.14
hd, final value	7.52	7.08	6.75	5.95	7.36	6.40	7.00	6.50
x, final value	0.19	0.28	0.42	0.45	0.22	0.09	0.33	0.27
Move-up time, m		2.3		2.3		2.3		2.3
Service Time	5.2	4.8	4.5	3.6	5.1	4.1	4.7	4.2

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	89	140	226	274	108	52	172	152
Service Time	5.2	4.8	4.5	3.6	5.1	4.1	4.7	4.2
Utilization, x	0.19	0.28	0.42	0.45	0.22	0.09	0.33	0.27
Dep. headway, hd	7.52	7.08	6.75	5.95	7.36	6.40	7.00	6.50
Capacity	339	390	476	524	358	302	422	402
Delay	11.93	12.46	14.33	13.47	12.13	9.75	13.17	11.65
LOS	B	B	B	B	B	A	B	B
Approach:								
Delay		12.25		13.86		11.36		12.46
LOS		B		B		B		B
Intersection Delay	12.85							

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	62	156	476	225	475	18	296	200	88	23	527	225
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	810	3168	1.02	0.26	68.7	E	68.7	E
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	880	3445	0.91	0.26	46.4	D	46.4	D
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	94	292	3.62	0.32	1234	F		
TR	586	1819	0.56	0.32	29.2	C	639.7	F

Southbound

LTR	854	2650	1.01	0.32	63.6	E	63.6	E
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 183.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	156	476	225	475	18	296	200	88	23	527	225
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	46	142	63	132	5	85	57	25	6	146	63
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		827			798		340	331			862	
%InSharedLn												
Prop LTs		0.089			0.313		1.000	0.000			0.030	
Prop RTs		0.686			0.025			0.305			0.290	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	156	476	225	475	18	296	200	88	23	527	225
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	74	186	567	250	528	20	340	230	101	26	586	250
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	827			798			340 331			862		
Prop LTs	0.089			0.313			1.000 0.000			0.030		
Prop RTs	0.686			0.025			0.305			0.290		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.971			0.971 0.971			0.893		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.897			0.996			0.954			0.956		
fLT	0.996			0.985			0.153 1.000			0.936		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3168			3445			292 1819			2650		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	827	3168	# 0.26	0.26	810	1.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	798	3445	# 0.23	0.26	880	0.91
Right							
Northbound							
Prot							
Perm							
Left	DefL	340	292	# 1.16	0.32	94	3.62
Prot							
Perm							
Thru	TR	331	1819	0.18	0.32	586	0.56
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	862	2650	0.33	0.32	854	1.01
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.66
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.99

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	1.02	0.26	33.5	1.000	810	0.50	35.2	0.0	68.7	E	68.7	E	
Westbound													
LTR	0.91	0.26	32.5	1.000	880	0.50	13.9	0.0	46.4	D	46.4	D	
Northbound													
DefL	3.62	0.32	30.5	1.000	94	0.50	1204	0.0	1234	F			
TR	0.56	0.32	25.3	1.000	586	0.50	3.9	0.0	29.2	C	639.7	F	
Southbound													
LTR	1.01	0.32	30.5	1.000	854	0.50	33.1	0.0	63.6	E	63.6	E	

Intersection delay = 183.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			340	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			862	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			8.50	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.32	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			15.50	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			13.50	
n=Max(gq-gf)/2,0)			7.75	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.04	
EL2=Max((1-Ptho*n)/Plto, 1.0)			7.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			15.50	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.15	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.153	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	26
Proportion of LT in LT lane group, PLT	0.089 0.313 0.000 0.030
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	331
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.65
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.14
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	10.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	1.18
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.82
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07
EL1 (refer to Exhibit C16-3)	1.94
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.936

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				1.18
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.041
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				331
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.030
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.686	0.025	0.305
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	4.2	0.0	68.7
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	32.5	0.00	0.0	0.0	46.4
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	61.5	0.0	1234
TR	0.0	0.00	30.5	25.3	0.00	0.0	0.0	29.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.5	0.00	2.0	0.0	63.6
	0.0						0.0	
Intersection Delay			183.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	434		419		340	331	452	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1663		1809		292	1819	1391	
LnCapacity	425		462		94	586	448	
Flow Ratio	0.3		0.2		1.2	0.2	0.3	
v/c Ratio	1.02		0.91		3.62	0.56	1.01	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.889		0.932			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	10.9		10.2		8.5	6.9	11.3	
kB	0.6		0.6		0.2	0.8	0.7	
Q2	6.1		3.6		31.0	1.0	6.3	
Q Average	16.9		13.8		39.5	7.8	17.6	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	20.4		16.6		47.5	9.6	21.2	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.4	
BOQ	23.9		19.5		55.4	11.5	24.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.5	
BOQ	25.7		21.1		59.3	12.6	26.7	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.7		1.6	1.8	1.6	
BOQ	27.7		22.9		63.3	14.2	28.7	
QSRatio								
98th Percentile Output:								
fB%	1.8		1.8		1.7	2.0	1.7	
BOQ	29.7		24.7		67.3	15.8	30.7	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R			LTR		L	LT R	
Volume	684	430	3	1	449	796	0	0	1	125	0	136
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	37.0	22.0			16.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	783	1711	0.96	0.71	35.5	D		
TR	1158	1628	0.41	0.71	6.1	A	24.1	C
Westbound								
LT	451	1843	1.07	0.24	86.8	F	427.9	F
R	383	1568	2.28	0.24	616.6	F		
Northbound								
LTR	328	1844	0.01	0.18	30.6	C	30.6	C
Southbound								
L	233	1313	0.55	0.18	42.9	D		
LT	320	1801	0.00	0.18	30.4	C	24.0	C
R	952	1478	0.15	0.64	6.6	A		

Intersection Delay = 216.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	684	430	3	1	449	796	0	0	1	125	0	136
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	188	118	1	1	121	219	0	0	1	32	0	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	752	476			484	875		4		129	0	140
%InSharedLn										0		
Prop LTs	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTs		0.006			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0		0		0			0		0		
Buses	0	0			0	0		0		0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0		0.0		0.0	0.0	0.0
Arriv. Type	3	3			3	3		3		3	3	3
Unit Ext.	3.0	3.0			3.0	3.0		3.0		3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ext of g	2.0	2.0			2.0	2.0		2.0		2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right		
Green		37.0	22.0					16.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	684	430	3	1	449	796	0	0	1	125	0	136
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
Adj flow	752	473	3	1	483	875	0	0	4	129	0	140
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L TR			LT R			LTR			L LT R		
Adj flow	752	476		484	875		4			129	0	140
Prop LTs	1.000	0.000		0.002			0.000			1.000	0.000	
Prop RTs	0.006			0.000	1.000		1.000			0.000	1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound		
	L	TR	LT	R	LTR		L	LT	R
So	1900	1900	1900	1900	1900		1900	1900	1900
Lanes	1	1 0	1 1	0	1 0		1	1	1
fW	0.967	1.000	1.000	1.000	1.133		0.933	0.967	0.933
fHV	0.980	0.980	0.971	0.971	0.990		0.980	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
fP	1.000	0.875	1.000	1.000	1.000		1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
fLU	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000
fRT		0.999	1.000	0.850	0.865			1.000	0.850
fLT	0.950	1.000	0.999		1.000		0.755	1.000	
Sec.	0.148								
fLpb	1.000	1.000	1.000		1.000		1.000	1.000	
fRpb		1.000	1.000	1.000	1.000			1.000	1.000
S	1711	1628	1843	1568	1844		1313	1801	1478
Sec.	267								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		703	1711	# 0.41	0.411	703	1.00
Perm		49	267	0.18	0.300	80	0.61
Left	L	752			0.71	783	0.96
Prot							
Perm							
Thru	TR	476	1628	0.29	0.71	1158	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1843	0.26	0.24	451	1.07
Right	R	875	1568	# 0.56	0.24	383	2.28
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	129	1313	# 0.10	0.18	233	0.55
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	140	1478	0.09	0.64	952	0.15

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.07
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.96	0.71	16.0	1.000	783	0.50	19.5	0.0	35.5	D			
TR	0.41	0.71	5.3	1.000	1158	0.50	0.8	0.0	6.1	A	24.1	C	
Westbound													
LT	1.07	0.24	34.0	1.000	451	0.50	52.8	0.0	86.8	F	427.9	F	
R	2.28	0.24	34.0	1.000	383	0.50	582.6	0.0	616.6	F			
Northbound													
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C	
Southbound													
L	0.55	0.18	33.7	1.000	233	0.50	9.2	0.0	42.9	D			
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	24.0	C	

R 0.15 0.64 6.3 1.000 952 0.50 0.3 0.0 6.6 A

Intersection delay = 216.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	27.0			16.0
Opposing effective green time, go (s)	22.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	752			129
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	484			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.80			3.23
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.10			0.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.76			0.82
gq, (see Exhibit C16-4,5,6,7,8)	25.01			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	1.99			16.00
n=Max(gq-gf)/2,0)	12.50			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.05			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	12.36			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.15			0.25
gdifff=max(gq-gf,0)	25.01			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.148			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		22.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		22.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	476	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600		0.03	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		11.90	0.00
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		15.7	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.29	0.82
gq, (see Exhibit C16-4,5,6,7,8)		0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.34	16.00
n=Max(gq-gf)/2,0)		0.00	0.00
PTHo=1-PLTo		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.00	0.00
EL1 (refer to Exhibit C16-3)		2.25	800.00
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.09	0.13
gdif=max(gq-gf,0)		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.999	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		22.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		476		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	64.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	64.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.006
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	752			
v/c ratio from Capacity Worksheet, X	0.96			
Protected phase effective green interval, g (s)	37.0			
Opposing queue effective green interval, gq	21.01			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	28.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.86			
XPerm	1.52			
XProt	0.77			
Case	3			
Queue at beginning of green arrow, Qa	7.64			
Queue at beginning of unsaturated green, Qu	4.39			
Residual queue, Qr	1.80			
Uniform Delay, d1	16.0			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		16.0	0.00	0.0	0.0	35.5
TR	0.0	0.00	13.0	5.3	0.00	0.0	0.0	6.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.0	34.0	0.00	8.3	0.0	86.8
R	0.0	0.00	34.0	34.0	0.00	123.0	0.0	616.6
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.9
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.0	6.3	0.00	0.0	0.0	6.6
Intersection Delay			216.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	752	476		484	875	4		129	0	140
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1102	1628		1843	1568	1844		1313	1801	1478
LnCapacity	783	1158		451	383	328		233	320	952
Flow Ratio	0.7	0.3		0.3	0.6	0.0		0.1	0.0	0.1
v/c Ratio	0.96	0.41		1.07	2.28	0.01		0.55	0.00	0.15
Grn Ratio	0.71	0.71		0.24	0.24	0.18		0.18	0.18	0.64
I Factor		0.735		0.546		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
Q1	9.0	4.9		12.1	21.9	0.1		2.9	0.0	1.4
kB	0.7	0.9		0.4	0.3	0.5		0.4	0.5	1.1
Q2	6.4	0.6		7.1	62.1	0.0		0.5	0.0	0.2
Q Average	15.4	5.5		19.2	83.9	0.1		3.4	0.0	1.6
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2	1.3		1.3	1.3	1.3
BOQ	18.6	6.8		23.1	101	0.1		4.3	0.0	2.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4	1.7		1.6	1.7	1.6
BOQ	21.8	8.3		27.1	118	0.2		5.3	0.0	2.5
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5	1.5	2.0		1.8	2.0	1.9
BOQ	23.5	9.2		29.1	126	0.2		6.0	0.0	2.9
QSRatio										
95th Percentile Output:										
fB%	1.6	1.9		1.6	1.6	2.6		2.1	2.6	2.3
BOQ	25.4	10.6		31.2	134	0.2		7.2	0.0	3.6
QSRatio										
98th Percentile Output:										
fB%	1.8	2.2		1.7	1.7	3.2		2.5	3.2	2.8
BOQ	27.3	12.1		33.3	143	0.3		8.4	0.0	4.4
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/9/2013	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2020 With-Action Alt
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4		5	6	7	8
EB	Left	P					NB Left	P		
	Thru	P					NB Thru	P		
	Right	P					NB Right	P		
	Peds	X					NB Peds	X		
WB	Left	P					SB Left	P		
	Thru	P					SB Thru	P		
	Right	P					SB Right	P		
	Peds	X					SB Peds	X		
NB	Right					EB	Right			
SB	Right					WB	Right			
Green		45.0					35.0			
Yellow		3.0					3.0			
All Red		2.0					2.0			

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	707	1413	0.81	0.50	28.1	C		
TR	1056	2111	0.04	0.50	11.5	B	26.9	C

LTR	1536	3071	0.09	0.50	11.9	B	11.9	B
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DefL	517	1329	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	539	1386	0.14	0.39	18.3	B	293.6	F
R	593	1524	1.63	0.39	315.9	F		

Intersection Delay = 180.4 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	143	10	0	1	18	20	2	1	0	18	2	327
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	570	42			131		7	5			78	964
%InSharedLn												
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0			0		0	0			0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	519	38	0	2	64	71	4	3	0	64	6	1178
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	570	42	0	2	70	59	7	5	0	71	7	964
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	570	42			131		7	5			78	964
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	DefL	TR		LTR			DefL	TR		LT	R	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	0	2	0	2	0		0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000	1.000		1.000	1.000	
fHV	0.980	0.980		0.971			0.990	0.990		0.943	0.943	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	1.000		0.952			1.000	1.000		1.000	1.000	
fRT		1.000		0.932				1.000		1.000	0.850	
fLT	0.669	1.000		0.954			0.706	1.000		0.773		
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000		
fRpb		1.000		1.000				1.000		1.000	1.000	
S	1413	2111		3071			1329	1881		1386	1524	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	570	1413	# 0.40	0.50	707	0.81
Prot							
Perm							
Thru	TR	42	2111	0.02	0.50	1056	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	131	3071	0.04	0.50	1536	0.09
Right							
Northbound							
Prot							
Perm							
Left	DefL	7	1329	0.01	0.39	517	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	78	1386	0.06	0.39	539	0.14
Right	R	964	1524	# 0.63	0.39	593	1.63

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.04
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.17

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.81	0.50	18.8	1.000	707	0.50	9.2	0.0	28.1	C			
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	26.9	C	
Westbound													
LTR	0.09	0.50	11.8	1.000	1536	0.50	0.1	0.0	11.9	B	11.9	B	
Northbound													
DefL	0.01	0.39	16.9	1.000	517	0.50	0.0	0.0	16.9	B			
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.14	0.39	17.8	1.000	539	0.50	0.5	0.0	18.3	B	293.6	F	

R 1.63 0.39 27.5 1.000 593 0.50 288.4 0.0 315.9 F

Intersection delay = 180.4 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	45.0		35.0	
Opposing effective green time, go (s)	45.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	570		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	131		78	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/3600	14.25		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.72		1.95	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.42	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.669		0.706	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gfgq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		35.0
Effective permitted green time for LT lane group, g(s)		45.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	71
Proportion of LT in LT lane group, PLT	0.000	0.015 0.000 0.910
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	42	5
Lost time for LT lane group, tL	5.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.78
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.52	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	35.6	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.40	30.75
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	131	42	78	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.015	1.000	0.910
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.450	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				90.0 sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	18.8	0.00	0.0	0.0	28.1
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.8	0.00	0.0	0.0	11.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	27.5	27.5	0.00	92.8	0.0	315.9
Intersection Delay			180.4	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound			Southbound		
LaneGroup	DefL	TR			LTR		DefL	TR		LT	R	
Init Queue	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Flow Rate	570	42			68		7	5		78	964	
So	1900	1900			1900		1900	1900		1900	1900	
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1413	2111			1612		1329	1881		1386	1524	
LnCapacity	707	1056			806		517	732		539	593	
Flow Ratio	0.4	0.0			0.0		0.0	0.0		0.1	0.6	
v/c Ratio	0.81	0.04			0.08		0.01	0.01		0.14	1.63	
Grn Ratio	0.50	0.50			0.50		0.39	0.39		0.39	0.39	
I Factor		0.962			1.000			1.000		0.889		
AT or PVG	3	3			3		3	3		3	3	
Pltn Ratio	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Q1	11.9	0.5			0.9		0.1	0.1		1.3	24.1	
kB	0.9	1.1			1.0		0.7	0.9		0.7	0.7	
Q2	3.0	0.0			0.1		0.0	0.0		0.1	48.1	
Q Average	15.0	0.6			1.0		0.1	0.1		1.4	72.2	
Q Spacing	25.0	25.0			25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0			0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3		1.3	1.3		1.3	1.2	
BOQ	18.1	0.8			1.3		0.2	0.1		1.8	86.7	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6		1.7	1.7		1.6	1.4	
BOQ	21.2	1.0			1.6		0.2	0.1		2.2	101	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9		2.0	2.0		1.9	1.5	
BOQ	22.8	1.1			1.9		0.2	0.2		2.6	108	
QSRatio												
95th Percentile Output:												
fB%	1.6	2.5			2.4		2.6	2.6		2.4	1.6	
BOQ	24.7	1.5			2.4		0.3	0.2		3.2	116	
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			2.9		3.2	3.2		2.8	1.7	
BOQ	26.6	1.8			2.9		0.4	0.3		3.9	123	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	264		25				4	262			694	616
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	537	1696	0.56	0.32	21.1	C	20.6	C
R	465	1468	0.05	0.32	14.4	B		
Westbound								

Northbound

LT	1649	3192	0.18	0.52	8.0	A	8.0	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1930	3736	0.85	0.52	15.9	B	15.9	B
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Intersection Delay = 15.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	264		25				4	262		694	616	
% Heavy Veh	10		10				4	4		2	2	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
PK 15 Vol	75		7				1	73		217	192	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	300		22					295			1637	
%InSharedLn												
Prop LTs								0.014			0.000	
Prop RTs			1.000					0.000			0.470	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.975						0.998			0.686	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	264		25				4	262		694	616	
PHF	0.88		0.88				0.90	0.90		0.80	0.80	
Adj flow	300		22				4	291		867	770	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	300		22					295			1637	
Prop LTs								0.014			0.000	
Prop RTs			1.000					0.000			0.470	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.909	0.909			0.962		0.980	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.929	
fLT	0.950				0.933		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1696	1468			3192		3736	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	300	1696	# 0.18	0.32	537	0.56
Prot							
Perm							
Thru							
Right	R	22	1468	0.01	0.32	465	0.05
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	295	3192	0.09	0.52	1649	0.18
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1637	3736	# 0.44	0.52	1930	0.85
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.62
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.74

Control Delay and LOS Determination														
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach			
	v/c	g/C							Delay	LOS	Delay	LOS		
Eastbound														
L	0.56	0.32	17.0	1.000	537	0.50	4.1	0.0	21.1	C	20.6	C		
R	0.05	0.32	14.2	1.000	465	0.50	0.2	0.0	14.4	B				
Westbound														
Northbound														
LT	0.18	0.52	7.7	1.000	1649	0.50	0.2	0.0	8.0	A	8.0	A		
Southbound														
TR	0.85	0.52	12.5	1.000	1930	0.50	3.4	0.0	15.9	B	15.9	B		

Intersection delay = 15.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	4
Proportion of LT in LT lane group, PLT	0.014 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1637
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.07
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.33
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	21.52
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	7.38
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.933

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			21.52	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.694	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1637	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.014	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.470
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	17.0	0.00	0.0	0.0	21.1
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.7	0.00	0.0	0.0	8.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	12.5	0.00	0.0	0.0	15.9
	0.0						0.0	
Intersection Delay			15.5	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	300	22				154		859	
So	1900	1900				1900		1900	
No.Lanes	1 0	1 0	0 0 0			2 0		2 0	
SL	1696	1468				1676		1962	
LnCapacity	537	465				866		1013	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.56	0.05				0.18		0.85	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.975				0.998		0.686	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	4.2	0.3				1.4		12.3	
kB	0.5	0.5				0.8		0.6	
Q2	0.7	0.0				0.2		2.9	
Q Average	4.8	0.3				1.5		15.2	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	6.0	0.4				2.0		18.3	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	7.3	0.5				2.5		21.5	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.9		1.5	
BOQ	8.2	0.5				2.9		23.2	
QSRatio									
95th Percentile Output:									
fB%	2.0	2.5				2.3		1.6	
BOQ	9.6	0.7				3.6		25.1	
QSRatio									
98th Percentile Output:									
fB%	2.3	3.1				2.8		1.8	
BOQ	11.0	0.9				4.3		26.9	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L			LTR		
Volume	1	0		623	1		1			23	686	0
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.01	0.42	10.2	B	10.2	B
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Westbound

L	612	1468	0.54	0.42	16.4	B		
LT	587	1409	0.56	0.42	17.1	B	16.8	B

Northbound

L	179	430	0.01	0.42	10.3	B	10.3	B
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Southbound

LTR	2040	4897	0.43	0.42	13.1	B	13.1	B
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Intersection Delay = 14.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		623	1		1			23	686	0
% Heavy Veh	1	1		1	1		1			2	2	2
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
PK 15 Vol	1	0		164	1		1			7	214	0
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	4			328	329		1			886		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.997		1.000				0.033	
Prop RTs	0.000			0.000						0.000		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.989		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		623	1		1			23	686	0
PHF	0.25	0.25		0.95	0.95		0.90			0.80	0.80	0.80
Adj flow	4	0		656	1		1			29	857	0
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	4			328	329		1			886		
Prop LTs	0.000			1.000 0.997			1.000			0.033		
Prop RTs	0.000			0.000						0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.990 0.990		0.990		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.755 0.725		0.245		0.998	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1468 1409		430		4897	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	4	1881	0.00	0.42	784	0.01
Right							
Westbound							
Prot							
Perm							
Left	L	328	1468	0.22	0.42	612	0.54
Prot							
Perm							
Thru	LT	329	1409	# 0.23	0.42	587	0.56
Right							
Northbound							
Prot							
Perm							
Left	L	1	430	0.00	0.42	179	0.01
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	886	4897	# 0.18	0.42	2040	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.41
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.01	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	0.54	0.42	13.1	1.000	612	0.50	3.3	0.0	16.4	B			
LT	0.56	0.42	13.3	1.000	587	0.50	3.8	0.0	17.1	B	16.8	B	
Northbound													
L	0.01	0.42	10.2	1.000	179	0.50	0.1	0.0	10.3	B	10.3	B	
Southbound													
LTR	0.43	0.42	12.5	1.000	2040	0.50	0.7	0.0	13.1	B	13.1	B	

Intersection delay = 14.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		328	1	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		4	886	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600		5.47	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	5.42	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.12	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	19.88	
n=Max(gq-gf)/2,0)		0.00	2.56	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	3.25	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.49	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	5.12	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.25	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.755	0.245	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	328		
Proportion of LT in LT lane group, PLT	0.000	0.997	0.033
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		4	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		5.47	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.07	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00-	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdif=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.725	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	4		328	329	1			325	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	3	0
SL	1881		1468	1409	430			1797	
LnCapacity	784		612	587	179			748	
Flow Ratio	0.0		0.2	0.2	0.0			0.2	
v/c Ratio	0.01		0.54	0.56	0.01			0.43	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.989			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		4.1	4.2	0.0			3.9	
kB	0.7		0.6	0.6	0.3			0.7	
Q2	0.0		0.7	0.7	0.0			0.5	
Q Average	0.0		4.8	4.9	0.0			4.4	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.2	1.3			1.2	
BOQ	0.1		5.9	6.1	0.0			5.5	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.5	1.7			1.5	
BOQ	0.1		7.3	7.4	0.0			6.7	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.7	1.7	2.0			1.7	
BOQ	0.1		8.1	8.3	0.0			7.5	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.0	2.0	2.6			2.0	
BOQ	0.1		9.5	9.7	0.0			8.9	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.3	2.3	3.2			2.3	
BOQ	0.1		10.9	11.1	0.0			10.2	
QSRatio									

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R

Volume	23
Peak-Hour Factor, PHF	0.55
Hourly Flow Rate, HFR	41
Percent Heavy Vehicles	-- -- -- --
Median Type/Storage	Undivided /
RT Channelized?	
Lanes	1
Configuration	T
Upstream Signal?	No No

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	525
Peak Hour Factor, PHF	0.90
Hourly Flow Rate, HFR	583
Percent Heavy Vehicles	1
Percent Grade (%)	0 0
Flared Approach: Exists?/Storage	/ /
Lanes	1
Configuration	R

Delay, Queue Length, and Level of Service

Approach Movement	EB	WB	Northbound			Southbound		
	1	4	7	8	9	10	11	12

v (vph)	583
C(m) (vph)	1033
v/c	0.56
95% queue length	3.65
Control Delay	12.9
LOS	B
Approach Delay	12.9
Approach LOS	B

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.55				
Peak-15 Minute Volume		10				
Hourly Flow Rate, HFR		41				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			525			
Peak Hour Factor, PHF			0.90			
Peak-15 Minute Volume			146			
Hourly Flow Rate, HFR			583			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					41			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	41	
Potential Capacity	1033	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1033	
Probability of Queue free St.	0.44	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.44
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.44
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			583			
Movement Capacity (vph)			1033			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1033			
Volume			583			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					583			
C(m) (vph)					1033			
v/c					0.56			
95% queue length					3.65			
Control Delay					12.9			
LOS					B			
Approach Delay				12.9				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	61	31	247	62	0	0	0	0	31	78	20
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.86		0.77				0.80 0.80	
Flow Rate	106		400				86 72	
% Heavy Veh	17		4				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25 hrs.							

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	106		400				86	72
Left-Turn	0		320				38	0
Right-Turn	36		0				0	24
Prop. Left-Turns	0.0		0.8				0.4	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.2		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 12-1 PM MD Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	40	53	0	0	266	23	42	63	88	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.86		0.77		0.88		0.88	
Flow Rate	107		374		82		136	
% Heavy Veh	11		5		1		1	
No. Lanes	1		1		2			
Opposing-Lanes	1		1		0			
Conflicting-lanes	2		2		1			
Geometry group	2		2		1			
Duration, T	0.25 hrs.							

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	107		374		82	136		
Left-Turn	46		0		47	0		
Right-Turn	0		29		0	100		
Prop. Left-Turns	0.4		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.1		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

_____Worksheet 4 - Departure Headway and Service Time_____

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	149	245	155	2	53	5	571	39	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	577	1650	0.75	0.35	25.9	C	23.5	C
R	560	1599	0.20	0.35	14.4	B		

Westbound

LTR	533	1523	0.12	0.35	13.7	B	13.7	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2286	4730	0.28	0.48	9.5	A	9.5	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 15.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	245	155	2	53	5	571	39	2			
% Heavy Veh	1	1	1	5	5	5	1	1	1			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
PK 15 Vol	41	67	43	1	14	2	147	10	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			52			0			0			
Adj Flow		433	113		63			631				
%InSharedLn												
Prop LTs		0.379			0.032			0.933				
Prop RTs		0.000	1.000		0.079			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.999			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0						29.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	245	155	2	53	5	571	39	2			
PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.97	0.97	0.97			
Adj flow	164	269	113	2	56	5	589	40	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT		R	LTR			LTR					
Adj flow	433		113	63			631					
Prop LTs	0.379			0.032			0.933					
Prop RTs	0.000		1.000	0.079			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		0.952			0.990				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.989			1.000				
fLT	0.849			0.989			0.955				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1650	1599		1523			4730				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	0.75	0.35	17.2	1.000	577	0.50	8.7	0.0	25.9	C	23.5	C
R	0.20	0.35	13.6	1.000	560	0.50	0.8	0.0	14.4	B		
Westbound												
LTR	0.12	0.35	13.2	1.000	533	0.50	0.5	0.0	13.7	B	13.7	B
Northbound												
LTR	0.28	0.48	9.2	1.000	2286	0.50	0.3	0.0	9.5	A	9.5	A
Southbound												

Intersection delay = 15.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	164	2	
Proportion of LT in LT lane group, PLT	0.379	0.032	0.933
Proportion of LT in opposing flow, PLTo	0.03	0.38	
Adjusted opposing flow rate, Vo (veh/h)	63	433	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	0.03	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.05	7.22	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	14.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	9.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	6.56	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.97	0.62	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.38	0.03	
EL1 (refer to Exhibit C16-3)	1.47	2.15	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.85	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.849	0.989	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	9.11		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.434		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	63	433	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.379	0.032	0.933	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.079	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	17.2	0.00	0.0	0.0	25.9
R	0.0	0.00	19.5	13.6	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.2	0.00	0.0	0.0	13.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			15.9	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	433	113	63	231			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1650	1599	1523	1736			
LnCapacity	577	560	533	839			
Flow Ratio	0.3	0.1	0.0	0.1			
v/c Ratio	0.75	0.20	0.12	0.28			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.999	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	6.4	1.3	0.7	2.3			
kB	0.6	0.6	0.6	0.7			
Q2	1.6	0.1	0.1	0.3			
Q Average	8.0	1.5	0.8	2.6			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	9.7	1.9	1.0	3.2			
QSRatio							
85th Percentile Output:							
fB%	1.5	1.6	1.7	1.6			
BOQ	11.7	2.4	1.3	4.1			
QSRatio							
90th Percentile Output:							
fB%	1.6	1.9	1.9	1.8			
BOQ	12.8	2.7	1.5	4.6			
QSRatio							
95th Percentile Output:							
fB%	1.8	2.3	2.5	2.2			
BOQ	14.4	3.4	1.9	5.7			
QSRatio							
98th Percentile Output:							
fB%	2.0	2.8	3.0	2.6			
BOQ	16.0	4.1	2.3	6.7			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Av & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	207		40				14	293		345	46	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 467 1752 0.65 0.27 26.3 C 26.3 C

Westbound

Northbound

LT 1091 1926 0.32 0.57 7.7 A 7.7 A

Southbound

TR 1168 2061 0.37 0.57 8.0 A 8.0 A

Intersection Delay = 13.0 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	207		40				14	293		345	46	
% Heavy Veh	1		1				2	2		2	2	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
PK 15 Vol	64		12				4	84		95	13	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		305						353			430	
%InSharedLn												
Prop LTs		0.839						0.045			0.000	
Prop RTs		0.161						0.000			0.119	
Peds Bikes	0			0						0		0
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.975						0.967			0.961	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	207		40				14	293		345	46	
PHF	0.81		0.81				0.87	0.87		0.91	0.91	
Adj flow	256		49				16	337		379	51	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		305						353			430	
Prop LTs		0.839						0.045			0.000	
Prop RTs	0.161						0.000			0.119		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.980			0.980		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.978						1.000			0.984		
fLT	0.960						0.977			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1752						1926			2061		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	305	1752	# 0.17	0.27	467	0.65
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	353	1926	0.18	0.57	1091	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	430	2061	# 0.21	0.57	1168	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.38
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.46

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.65	0.27	19.5	1.000	467	0.50	6.8	0.0	26.3	C	26.3	C
Westbound												
Northbound												
LT	0.32	0.57	6.9	1.000	1091	0.50	0.8	0.0	7.7	A	7.7	A
Southbound												
TR	0.37	0.57	7.1	1.000	1168	0.50	0.9	0.0	8.0	A	8.0	A

Intersection delay = 13.0 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		16	
Proportion of LT in LT lane group, PLT	0.839	0.045	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		430	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.27	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		7.17	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		18.4	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		4.13	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		15.62	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.05	
EL1 (refer to Exhibit C16-3)		2.14	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.977	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			4.13	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.121	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			430	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.045	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.119
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	22.0	19.5	0.00	0.0	0.0 0.0 0.0	26.3
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	13.0	6.9	0.00	0.0	0.0 0.0 0.0	7.7
Southbound								
TR	0.0 0.0 0.0	0.00	13.0	7.1	0.00	0.0	0.0 0.0 0.0	8.0
Intersection Delay			13.0	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	305						353			430		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1752						1926			2061		
LnCapacity	467						1091			1168		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.65						0.32			0.37		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.975						0.967			0.961		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.5						3.1			3.9		
kB	0.5						0.9			0.9		
Q2	0.9						0.4			0.5		
Q Average	5.4						3.5			4.5		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.7						4.4			5.5		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	8.1						5.5			6.8		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.7			1.7		
BOQ	9.0						6.2			7.6		
QSRatio												
95th Percentile Output:												
fB%	1.9						2.1			2.0		
BOQ	10.5						7.4			9.0		
QSRatio												
98th Percentile Output:												
fB%	2.2						2.4			2.3		
BOQ	11.9						8.6			10.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	87		54				44	455		307	245	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								14	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	555	1666	0.30	0.33	16.1	B	16.1	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	840	1679	0.68	0.50	15.5	B	15.5	B
----	-----	------	------	------	------	---	------	---

Southbound

TR	996	1992	0.59	0.50	13.2	B	13.2	B
----	-----	------	------	------	------	---	------	---

Intersection Delay = 14.5 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	87		54				44	455		307	245	
% Heavy Veh	4		4				2	2		1	1	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
PK 15 Vol	25		16				13	131		84	67	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									14
Adj Flow		164						574			591	
%InSharedLn												
Prop LTs		0.616						0.089			0.000	
Prop RTs		0.384						0.000			0.430	
Peds Bikes	0	0		0						0	0	
Buses		0						2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.986						0.905			0.957	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	87		54				44	455		307	245	
PHF	0.86		0.86				0.87	0.87		0.91	0.91	
Adj flow	101		63				51	523		337	254	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		164						574			591	
Prop LTs		0.616						0.089			0.000	
Prop RTs	0.384						0.000			0.430		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.962						0.980			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.992		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.948						1.000			0.942		
fLT	0.970						0.916			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1666						1679			1992		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	164	1666	# 0.10	0.33	555	0.30
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	574	1679	# 0.34	0.50	840	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	591	1992	0.30	0.50	996	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.44
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.53

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.30	0.33	14.8	1.000	555	0.50	1.3	0.0	16.1	B	16.1	B
Westbound												
Northbound												
LT	0.68	0.50	11.4	1.000	840	0.50	4.1	0.0	15.5	B	15.5	B
Southbound												
TR	0.59	0.50	10.7	1.000	996	0.50	2.5	0.0	13.2	B	13.2	B

Intersection delay = 14.5 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		51	
Proportion of LT in LT lane group, PLT	0.616	0.089	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		591	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.85	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.85	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		8.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		8.54	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		21.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.09	
EL1 (refer to Exhibit C16-3)		2.51	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.916	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			8.54	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.285	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		591	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.616		0.089	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.384	0.430
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LR	0.0 0.0 0.0	0.00	20.0	14.8	0.00	0.0	0.0 0.0 0.0	16.1
Westbound								
	0.0 0.0 0.0						0.0 0.0 0.0	
Northbound								
LT	0.0 0.0 0.0	0.00	15.0	11.4	0.00	0.0	0.0 0.0 0.0	15.5
Southbound								
TR	0.0 0.0 0.0	0.00	15.0	10.7	0.00	0.0	0.0 0.0 0.0	13.2
Intersection Delay			14.5	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	164						574			591		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1666						1679			1992		
LnCapacity	555						840			996		
Flow Ratio	0.1						0.3			0.3		
v/c Ratio	0.30						0.68			0.59		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.986						0.905			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	2.0						7.3			7.0		
kB	0.6						0.7			0.8		
Q2	0.2						1.4			1.2		
Q Average	2.3						8.7			8.2		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2		
BOQ	2.9						10.6			10.0		
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5		
BOQ	3.6						12.6			11.9		
QSRatio												
90th Percentile Output:												
fB%	1.8						1.6			1.6		
BOQ	4.1						13.8			13.1		
QSRatio												
95th Percentile Output:												
fB%	2.2						1.8			1.8		
BOQ	5.0						15.4			14.7		
QSRatio												
98th Percentile Output:												
fB%	2.7						2.0			2.0		
BOQ	6.0						17.1			16.3		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	10		147	230	469	127	111	171		353		32
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.06	0.13	23.1	C		
R	220	1652	0.87	0.13	55.3	E	53.2	D
Westbound								
LTR	1339	4726	0.71	0.28	21.6	C	21.6	C
Northbound								
L	163	489	0.77	0.33	45.0	D		
T	593	1778	0.32	0.33	16.3	B	27.6	C
Southbound								
TR	690	2070	0.62	0.33	20.2	C	20.2	C

Intersection Delay = 25.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10		147	230	469	127	111	171		353	32	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		48	66	135	36	31	48		98	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	13		191		949		125	192			428	
%InSharedLn												
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000		0.084		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10		147	230	469	127	111	171		353	32	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	13		191	264	539	146	125	192		392	36	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	13		191		949		125	192			428	
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000			0.084	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.943	0.943	0.980	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.992	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.977			1.000	0.989	
fLT	0.950		0.986		0.273	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4726		489	1778	2070	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	1668	0.01	0.13	222	0.06
Prot							
Perm							
Thru							
Right	R	191	1652	# 0.12	0.13	220	0.87
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	949	4726	# 0.20	0.28	1339	0.71
Right							
Northbound							
Prot							
Perm							
Left	L	125	489	# 0.26	0.33	163	0.77
Prot							
Perm							
Thru	T	192	1778	0.11	0.33	593	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	428	2070	0.21	0.33	690	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.06	0.13	22.7	1.000	222	0.50	0.4	0.0	23.1	C	53.2	D	
R	0.87	0.13	25.5	1.000	220	0.50	29.8	0.0	55.3	E			
Westbound													
LTR	0.71	0.28	19.3	1.000	1339	0.50	2.3	0.0	21.6	C	21.6	C	
Northbound													
L	0.77	0.33	17.9	1.000	163	0.50	27.1	0.0	45.0	D	27.6	C	
T	0.32	0.33	14.9	1.000	593	0.50	1.4	0.0	16.3	B			
Southbound													
TR	0.62	0.33	16.8	1.000	690	0.50	3.4	0.0	20.2	C	20.2	C	

Intersection delay = 25.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			125	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			428	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.08	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.13	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			9.37	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			10.63	
n=Max(gq-gf)/2,0)			4.68	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.95	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.273	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.278 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.37	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.468	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			428	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.154	0.084
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.7	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	25.5	0.00	0.0	0.0	55.3
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	19.3	0.00	0.0	0.0	21.6
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	17.9	0.00	0.0	0.0	45.0
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.8	0.00	0.0	0.0	20.2
	0.0						0.0	
Intersection Delay			25.7	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	13	191		348		125	192		428
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1734		489	1778		2070
LnCapacity	222	220		491		163	593		690
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.2
v/c Ratio	0.06	0.87		0.71		0.77	0.32		0.62
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	3.1		5.2		1.9	2.4		6.0
kB	0.2	0.2		0.4		0.2	0.6		0.5
Q2	0.0	1.2		0.9		0.7	0.3		0.9
Q Average	0.2	4.3		6.1		2.5	2.7		6.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.3	5.4		7.5		3.2	3.3		8.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.5
BOQ	0.3	6.6		9.1		4.0	4.2		10.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.6
BOQ	0.4	7.4		10.0		4.5	4.8		11.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.0		1.9		2.2	2.2		1.9
BOQ	0.5	8.8		11.5		5.6	5.8		12.7
QSRatio									
98th Percentile Output:									
fB%	3.1	2.3		2.1		2.6	2.6		2.1
BOQ	0.6	10.1		13.0		6.6	6.9		14.3
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 08/21/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	5	15	8				6	276	116	228	473	28
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 454 1604 0.10 0.28 16.3 B 16.3 B

Westbound

Northbound

LTR 925 1682 0.48 0.55 10.0- A 10.0- A

Southbound

L 509 926 0.50 0.55 11.1 B
 TR 1018 1851 0.55 0.55 10.4 B 10.6 B

Intersection Delay = 10.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/21/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	15	8				6	276	116	228	473	28
% Heavy Veh	2	2	2				6	6	6	1	1	1
PHF	0.63	0.63	0.63				0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	6	3				2	78	33	63	131	8
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			0
Adj Flow		45						447		253	557	
%InSharedLn												
Prop LTS		0.178						0.016		1.000	0.000	
Prop RTS		0.289						0.291		0.056		
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.932			0.785	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	5	15	8						6	276	116		228	473	28
PHF	0.63	0.63	0.63						0.89	0.89	0.89		0.90	0.90	0.90
Adj flow	8	24	13						7	310	130		253	526	31
No. Lanes	0	1	0		0	0	0		0	1	0		1	1	0
Lane group	LTR								LTR				L TR		
Adj flow		45								447			253	557	
Prop LTs		0.178								0.016			1.000	0.000	
Prop RTs		0.289								0.291				0.056	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L TR		
So	1900						1900			1900 1900		
Lanes 0	1	0	0	0	0	0	1	0		1	1	0
fW	1.033						1.133			1.000 1.000		
fHV	0.980						0.943			0.990 0.990		
fG	1.000						1.000			1.000 1.000		
fP	0.875						0.875			1.000 1.000		
fBB	1.000						0.992			1.000 0.992		
fA	1.000						1.000			1.000 1.000		
fLU	1.000						1.000			1.000 1.000		
fRT	0.961						0.961			0.992		
fLT	0.991						0.993			0.492 1.000		
Sec.												
fLpb	1.000						1.000			1.000 1.000		
fRpb	1.000						1.000			1.000		
S	1604						1682			926 1851		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	45	1604	# 0.03	0.28	454	0.10
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	447	1682	0.27	0.55	925	0.48
Right							
Southbound							
Prot							
Perm							
Left	L	253	926	0.27	0.55	509	0.50
Prot							
Perm							
Thru	TR	557	1851	# 0.30	0.55	1018	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.33

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.39

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.10	0.28	15.9	1.000	454	0.50	0.4	0.0	16.3	B	16.3	B
Westbound												
Northbound												
LTR	0.48	0.55	8.3	1.000	925	0.50	1.7	0.0	10.0-	A	10.0-	A
Southbound												
L	0.50	0.55	8.4	1.000	509	0.50	2.7	0.0	11.1	B		
TR	0.55	0.55	8.7	1.000	1018	0.50	1.7	0.0	10.4	B	10.6	B

Intersection delay = 10.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				253
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				447
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.22
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.45
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				4.79
gu=g-gq if gq>=gf, or = g-gf if gq<gf				28.21
n=Max(gq-gf)/2,0)				2.39
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.98
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.37
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				4.79
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.49
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.492

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	7
Proportion of LT in LT lane group, PLT	0.178
Proportion of LT in opposing flow, PLTo	0.016 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	557
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.12
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.28
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	22.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	6.57
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.68
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.02
EL1 (refer to Exhibit C16-3)	2.43
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.993

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			6.57	4.79
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.199	0.145
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			557	447
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.016	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.289	0.291	0.056
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	15.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	8.4	0.00	0.0	0.0	11.1
TR	0.0	0.00	13.5	8.7	0.00	0.0	0.0	10.4
	0.0						0.0	
Intersection Delay			10.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	45						447			253	557	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1604						1682			926	1851	
LnCapacity	454						925			509	1018	
Flow Ratio	0.0						0.3			0.3	0.3	
v/c Ratio	0.10						0.48			0.50	0.55	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.932				0.785	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	0.6						4.6			2.6	6.0	
kB	0.5						0.8			0.4	0.7	
Q2	0.1						0.7			0.4	0.8	
Q Average	0.6						5.3			3.0	6.8	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.3	1.2	
BOQ	0.8						6.5			3.8	8.3	
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.6	1.5	
BOQ	1.0						7.9			4.7	10.0	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.8	1.6	
BOQ	1.2						8.8			5.4	11.1	
QSRatio												
95th Percentile Output:												
fB%	2.5						1.9			2.1	1.9	
BOQ	1.5						10.3			6.5	12.6	
QSRatio												
98th Percentile Output:												
fB%	3.0						2.2			2.5	2.1	
BOQ	1.8						11.7			7.6	14.2	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 08/21/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	5	8	17	265	26	105	21	288	170	90	371	19
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	628	1413	0.06	0.44	14.5	B	14.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	547	1231	0.58	0.44	22.3	C		
T	763	1717	0.04	0.44	14.2	B	20.1	C
R	563	1266	0.22	0.44	16.2	B		

Northbound

LTR	694	1562	0.78	0.44	26.8	C	26.8	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	620	1396	0.86	0.44	32.5	C	32.5	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 26.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/21/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	5	8	17	265	26	105	21	288	170	90	371	19
% Heavy Veh	2	2	2	7	7	7	6	6	6	2	2	2
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
PK 15 Vol	2	3	5	79	8	31	6	81	48	25	103	5
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900	1900	1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol			0			0			0			0
Adj Flow	38			315	31	125	539			533		
%InSharedLn												
Prop LTS		0.158		1.000	0.000			0.045			0.188	
Prop RTS	0.579			0.000	1.000		0.354			0.039		
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0	0.0	0.0			0.0		
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000			0.830			0.650			0.650		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5			11.8			18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	5	8	17	265	26	105	21	288	170	90	371	19
PHF	0.78	0.78	0.78	0.84	0.84	0.84	0.89	0.89	0.89	0.90	0.90	0.90
Adj flow	6	10	22	315	31	125	24	324	191	100	412	21
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	38			315	31	125	539			533		
Prop LTs	0.158			1.000	0.000		0.045			0.188		
Prop RTs	0.579			0.000 1.000			0.354			0.039		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound	
LG	LTR		L	T	R	LTR		LTR	
So	1900		1900	1900	1900	1900		1900	
Lanes	0	1	0	1	1	0	1	0	0
fw	1.000		1.000	0.967	0.967	0.967		1.000	
fHV	0.980		0.935	0.935	0.935	0.943		0.980	
fG	1.000		1.000	1.000	1.000	1.000		1.000	
fP	0.875		1.000	1.000	0.875	1.000		1.000	
fBB	0.992		1.000	1.000	0.992	1.000		1.000	
fA	1.000		1.000	1.000	1.000	1.000		1.000	
fLU	1.000		1.000	1.000	1.000	1.000		1.000	
fRT	0.922			1.000	0.850	0.952		0.995	
fLT	0.980		0.732	1.000		0.966		0.757	
Sec.									
fLpb	1.000		0.947	1.000		1.000		0.996	
fRpb	0.968			1.000	1.000	0.980		1.000	
S	1413		1231	1717	1266	1562		1396	
Sec.									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	38	1413	0.03	0.44	628	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	315	1231	# 0.26	0.44	547	0.58
Prot							
Perm							
Thru	T	31	1717	0.02	0.44	763	0.04
Right	R	125	1266	0.10	0.44	563	0.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	539	1562	0.35	0.44	694	0.78
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	533	1396	# 0.38	0.44	620	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.72

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.06	0.44	14.3	1.000	628	0.50	0.2	0.0	14.5	B	14.5	B
Westbound												
L	0.58	0.44	18.7	1.000	547	0.50	3.6	0.0	22.3	C		
T	0.04	0.44	14.1	1.000	763	0.50	0.1	0.0	14.2	B	20.1	C
R	0.22	0.44	15.4	1.000	563	0.50	0.8	0.0	16.2	B		
Northbound												
LTR	0.78	0.44	21.2	1.000	694	0.50	5.6	0.0	26.8	C	26.8	C
Southbound												
LTR	0.86	0.44	22.5	1.000	620	0.50	10.0	0.0	32.5	C	32.5	C

Intersection delay = 26.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		315		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		38		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.95		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.732		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	6	24	100
Proportion of LT in LT lane group, PLT	0.158	0.000	0.045
Proportion of LT in opposing flow, PLTo	0.00	0.19	0.04
Adjusted opposing flow rate, Vo (veh/h)	31	533	539
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.15	0.60	2.50
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.77	13.32	13.48
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.9	16.4	3.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.06	14.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.10	23.56	25.78
n=Max(gq-gf)/2,0)	0.00	0.00	5.28
PTHo=1-PLTo	1.00	0.81	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.19
EL1 (refer to Exhibit C16-3)	1.42	2.38	2.39
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.80
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdif=max(gq-gf,0)	0.00	0.00	10.57
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.980	0.966	0.757

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	14.06	14.22
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.352	0.356
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	31	38	533	539
OCCr	0.000	0.053	0.000	0.022
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.978
Proportion of left turns, PLT	0.158	1.000	0.045	0.188
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.579	1.000	0.354	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.968	1.000	0.980	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	14.3	0.00	0.0	0.0 0.0 0.0	14.5
Westbound								
L	0.0	0.00	25.0	18.7	0.00	0.0	0.0	22.3
T	0.0	0.00	25.0	14.1	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.4	0.00	0.0	0.0	16.2
Northbound								
LTR	0.0 0.0 0.0	0.00	25.0	21.2	0.00	0.0	0.0 0.0 0.0	26.8
Southbound								
LTR	0.0 0.0 0.0	0.00	25.0	22.5	0.00	0.0	0.0 0.0 0.0	32.5

Intersection Delay	26.4	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	38		315	31	125	539		533	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1413		1231	1717	1266	1562		1396	
LnCapacity	628		547	763	563	694		620	
Flow Ratio	0.0		0.3	0.0	0.1	0.3		0.4	
v/c Ratio	0.06		0.58	0.04	0.22	0.78		0.86	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.830			0.650		0.650	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.5		5.9	0.4	1.9	11.4		12.0	
kB	0.8		0.6	0.8	0.6	0.6		0.5	
Q2	0.1		0.8	0.0	0.2	1.8		2.6	
Q Average	0.6		6.7	0.5	2.1	13.3		14.6	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fb%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	0.8		8.2	0.6	2.7	16.0		17.6	
QSRatio									
85th Percentile Output:									
fb%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	1.0		9.9	0.8	3.4	18.8		20.7	
QSRatio									
90th Percentile Output:									
fb%	1.9		1.6	2.0	1.8	1.5		1.5	
BOQ	1.2		10.9	0.9	3.9	20.4		22.3	
QSRatio									
95th Percentile Output:									
fb%	2.5		1.9	2.5	2.3	1.7		1.7	
BOQ	1.5		12.5	1.2	4.8	22.2		24.2	
QSRatio									
98th Percentile Output:									
fb%	3.0		2.1	3.1	2.7	1.8		1.8	
BOQ	1.8		14.0	1.4	5.7	23.9		26.0	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	204		188	209	234		195		191			
Lane Width	16.0			16.0			11.0					
RTOR Vol			44						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	923	1845	0.42	0.50	15.6	B	15.6	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	505	1009	0.96	0.50	53.6	D	53.6	D
----	-----	------	------	------	------	---	------	---

Northbound

LR	558	1434	0.79	0.39	34.2	C	34.2	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 35.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		204	188	209	234		195		191			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		57	52	57	64		55		54			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			44						0			
Adj Flow		387			487			439				
%InSharedLn												
Prop LTs		0.000			0.472			0.506				
Prop RTs		0.413			0.000			0.494				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		204	188	209	234		195		191			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		227	160	230	257		222		217			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		387			487			439				
Prop LTs		0.000			0.472			0.506				
Prop RTs		0.413			0.000			0.494				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.926			0.862			0.980					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.944			1.000			0.933					
fLT	1.000			0.544			0.975					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1845			1009			1434					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.42	0.50	14.2	1.000	923	0.50	1.3	0.0	15.6	B	15.6	B
Westbound												
LT	0.96	0.50	21.7	1.000	505	0.50	31.9	0.0	53.6	D	53.6	D
Northbound												
LR	0.79	0.39	24.2	1.000	558	0.50	9.9	0.0	34.2	C	34.2	C
Southbound												

Intersection delay = 35.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	230		
Proportion of LT in LT lane group, PLT	0.000	0.472	0.506
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	387		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	5.75		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.68		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	8.36		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	36.64		
n=Max(gq-gf)/2,0)	4.18		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.47		
EL1 (refer to Exhibit C16-3)	2.05		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.54		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.544		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	14.2	0.00	0.0	0.0	15.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	21.7	0.00	0.0	0.0	53.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	24.2	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			35.9	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		387			487			439				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1845			1009			1434				
LnCapacity		923			505			558				
Flow Ratio		0.2			0.5			0.3				
v/c Ratio		0.42			0.96			0.79				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.961			0.989			0.922				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		6.1			11.8			9.7				
kB		1.0			0.7			0.7				
Q2		0.7			5.5			2.2				
Q Average		6.9			17.3			11.9				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		8.4			20.8			14.4				
QSRatio												
85th Percentile Output:												
fB%		1.5			1.4			1.4				
BOQ		10.1			24.3			17.0				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.5				
BOQ		11.2			26.2			18.4				
QSRatio												
95th Percentile Output:												
fB%		1.9			1.6			1.7				
BOQ		12.7			28.2			20.2				
QSRatio												
98th Percentile Output:												
fB%		2.1			1.7			1.8				
BOQ		14.3			30.2			21.9				
QSRatio												

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	34	18	29	68	17	34	29	276	87	58	296	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 230 1968 0.41 0.12 30.0 C 30.0 C

Westbound

LTR 498 1993 0.30 0.25 19.7 B 19.7 B

Northbound

LTR 712 1858 0.63 0.38 19.3 B 19.3 B

Southbound

LTR 646 1684 0.73 0.38 23.0 C 23.0 C

Intersection Delay = 21.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	34	18	29	68	17	34	29	276	87	58	296	28
% Heavy Veh	2	2	2	1	1	1	6	6	6	9	9	9
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
PK 15 Vol	10	5	8	21	5	10	8	79	25	18	91	9
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		95			147			450			472	
%InSharedLn												
Prop LTs		0.421			0.571			0.073			0.153	
Prop RTs		0.358			0.286			0.222			0.074	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	34	18	29	68	17	34	29	276	87	58	296	28
PHF	0.86	0.86	0.86	0.81	0.81	0.81	0.87	0.87	0.87	0.81	0.81	0.81
Adj flow	40	21	34	84	21	42	33	317	100	72	365	35
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	95			147			450			472		
Prop LTs	0.421			0.571			0.073			0.153		
Prop RTs	0.358			0.286			0.222			0.074		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	0.980			0.990			0.943			0.917		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.952			0.961			0.970			0.990		
fLT	0.979			0.972			0.950			0.868		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1968			1993			1858			1684		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	95	1968	# 0.05	0.12	230	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	147	1993	# 0.07	0.25	498	0.30
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	450	1858	0.24	0.38	712	0.63
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	472	1684	# 0.28	0.38	646	0.73
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.40
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.41	0.12	24.6	1.000	230	0.50	5.4	0.0	30.0	C	30.0	C
Westbound												
LTR	0.30	0.25	18.2	1.000	498	0.50	1.5	0.0	19.7	B	19.7	B
Northbound												
LTR	0.63	0.38	15.1	1.000	712	0.50	4.2	0.0	19.3	B	19.3	B
Southbound												
LTR	0.73	0.38	15.8	1.000	646	0.50	7.1	0.0	23.0	C	23.0	C

Intersection delay = 21.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			33	72
Proportion of LT in LT lane group, PLT	0.421	0.571	0.073	0.153
Proportion of LT in opposing flow, PLTo			0.15	0.07
Adjusted opposing flow rate, Vo (veh/h)			472	450
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.55	1.20
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.87	7.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			7.7	3.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			9.25	8.74
gu=g-gq if gq>=gf, or = g-gf if gq<gf			13.75	14.26
n=Max(gq-gf)/2,0)			0.75	2.49
PTHo=1-PLTo			0.85	0.93
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.07	0.15
EL1 (refer to Exhibit C16-3)			2.24	2.19
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	2.35
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.10
gdifff=max(gq-gf,0)			1.51	4.97
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.95	0.87
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.950	0.868

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.74
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.380
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				450
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.153
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.358	0.222
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	24.6	0.00	0.0	0.0	30.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.2	0.00	0.0	0.0	19.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	15.1	0.00	0.0	0.0	19.3
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	15.8	0.00	0.0	0.0	23.0
	0.0						0.0	
Intersection Delay			21.7	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	95		147		450		472	
So	1900		1900		1900		1900	
No.Lanes	0 1 0	0	0 1 0	0	0 1 0	0	0 1 0	
SL	1968		1993		1858		1684	
LnCapacity	230		498		712		646	
Flow Ratio	0.0		0.1		0.2		0.3	
v/c Ratio	0.41		0.30		0.63		0.73	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	1.5		2.0		6.1		6.7	
kB	0.3		0.5		0.7		0.6	
Q2	0.2		0.2		1.1		1.6	
Q Average	1.7		2.2		7.2		8.3	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.3		1.2		1.2	
BOQ	2.1		2.8		8.8		10.2	
QSRatio								
85th Percentile Output:								
fB%	1.6		1.6		1.5		1.5	
BOQ	2.7		3.5		10.6		12.1	
QSRatio								
90th Percentile Output:								
fB%	1.9		1.8		1.6		1.6	
BOQ	3.1		4.0		11.7		13.3	
QSRatio								
95th Percentile Output:								
fB%	2.3		2.2		1.8		1.8	
BOQ	3.9		4.9		13.3		14.9	
QSRatio								
98th Percentile Output:								
fB%	2.8		2.7		2.1		2.0	
BOQ	4.7		5.9		14.8		16.5	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			344	53		43	349	
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81	
Hourly Flow Rate, HFR			395	60		53	430	
Percent Heavy Vehicles			--	--		7	--	--
Median Type/Storage		Undivided			/			
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	

Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		55		49				
Peak Hour Factor, PHF		0.68		0.68				
Hourly Flow Rate, HFR		80		72				
Percent Heavy Vehicles		7		7				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach	NB		SB		Westbound			Eastbound		
Movement	1		4	7	8	9		10	11	12
Lane Config			LT		LR					
v (vph)			53		152					
C(m) (vph)			1080		362					
v/c			0.05		0.42					
95% queue length			0.15		2.02					
Control Delay			8.5		22.0					
LOS			A		C					
Approach Delay					22.0					
Approach LOS					C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		344	53	43	349	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		99	15	13	108	
Hourly Flow Rate, HFR		395	60	53	430	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	55		49			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	20		18			
Hourly Flow Rate, HFR	80		72			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		430
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		455	961		425			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
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Conflicting Flows	425	
Potential Capacity	619	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	619	
Probability of Queue free St.	0.88	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	455	
Potential Capacity	1080	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1080	
Probability of Queue free St.	0.95	1.00
Maj L-Shared Prob Q free St.	0.93	

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.93	0.93
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	961	
Potential Capacity	278	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.93
Maj. L, Min T Adj. Imp Factor.		0.95
Cap. Adj. factor due to Impeding mvmnt	0.95	0.84
Movement Capacity	264	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.93 0.93
Movement Capacity

Result for 2 stage process:

a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 961
Potential Capacity 278
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.93
Maj. L, Min T Adj. Imp Factor. 0.95
Cap. Adj. factor due to Impeding mvmnt 0.95 0.84
Movement Capacity 264

Results for Two-stage process:

a
y
C t 264

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	80		72			
Movement Capacity (vph)	264		619			
Shared Lane Capacity (vph)		362				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	264		619			
Volume	80		72			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		362				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		53		152				
C(m) (vph)		1080		362				
v/c		0.05		0.42				
95% queue length		0.15		2.02				
Control Delay		8.5		22.0				
LOS		A		C				
Approach Delay				22.0				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.95
v(i1), Volume for stream 2 or 5		430
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.93
d(M,LT), Delay for stream 1 or 4		8.5
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.6

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	11	2	377	20	386	4	167	362	308	278	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	725	1740	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	528	1268	0.92	0.42	38.6	D	37.5	D
R	523	1256	0.90	0.42	36.4	D		

Northbound

LTR	741	1779	0.77	0.42	22.2	C	22.2	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	380	913	1.79	0.42	385.5	F	385.5	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 140.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	377	20	386	4	167	362	308	278	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	115	6	118	1	45	97	90	81	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			484	471		573			682	
%InSharedLn												
Prop LTs		0.063			0.950			0.007			0.525	
Prop RTs		0.125			0.000	1.000		0.679			0.001	
Peds Bikes	0			0	0		0			0	0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	377	20	386	4	167	362	308	278	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	460	24	471	4	180	389	358	323	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			484 471			573			682		
Prop LTs	0.063			0.950			0.007			0.525		
Prop RTs	0.125			0.000 1.000			0.679			0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.983			1.000 0.850			0.908			1.000		
fLT	0.982			0.725			0.996			0.457		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1740			1268 1256			1779			913		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1740	0.01	0.42	725	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1268	# 0.38	0.42	528	0.92
Right	R	471	1256	0.38	0.42	523	0.90
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	573	1779	0.32	0.42	741	0.77
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	682	913	# 0.75	0.42	380	1.79
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.13
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.35

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	725	0.50	0.1	0.0	10.4	B	10.4	B	
Westbound													
LT	0.92	0.42	16.5	1.000	528	0.50	22.0	0.0	38.6	D	37.5	D	
R	0.90	0.42	16.3	1.000	523	0.50	20.1	0.0	36.4	D			
Northbound													
LTR	0.77	0.42	15.1	1.000	741	0.50	7.1	0.0	22.2	C	22.2	C	
Southbound													
LTR	1.79	0.42	17.5	1.000	380	0.50	368.0	0.0	385.5	F	385.5	F	

Intersection delay = 140.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	460	4	358
Proportion of LT in LT lane group, PLT	0.063	0.950	0.007	0.525
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.52	0.01
Adjusted opposing flow rate, Vo (veh/h)	484	16	682	573
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.67	0.07	5.97
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.07	0.27	11.37	9.55
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.69	0.00	12.78	10.57
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	14.43
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	5.29
PTHo=1-PLTo	0.05	0.94	0.48	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.01	0.52
EL1 (refer to Exhibit C16-3)	2.26	1.40	2.75	2.47
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	5.21
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	10.57
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.46
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.725	0.996	0.457

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.69		12.78	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.348		0.511	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	484		682	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.001
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.5	0.00	0.0	0.0	38.6
R	0.0	0.00	17.5	16.3	0.00	0.0	0.0	36.4
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.1	0.00	0.0	0.0	22.2
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	75.5	0.0	385.5
	0.0						0.0	
Intersection Delay			140.0	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	16			484	471	573			682			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1740			1268	1256	1779			913			
LnCapacity	725			528	523	741			380			
Flow Ratio	0.0			0.4	0.4	0.3			0.7			
v/c Ratio	0.02			0.92	0.90	0.77			1.79			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.933		0.919			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.2			7.6	7.3	8.2			11.4			
kB	0.7			0.5	0.5	0.6			0.4			
Q2	0.0			3.5	3.1	2.0			38.7			
Q Average	0.2			11.1	10.5	10.2			50.1			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			13.4	12.7	12.4			60.1			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.4	1.4	1.4			1.4			
BOQ	0.3			15.9	15.0	14.7			70.1			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.6	1.6			1.5			
BOQ	0.3			17.2	16.3	16.0			75.1			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.7	1.7	1.7			1.6			
BOQ	0.4			18.9	18.0	17.7			80.1			
QSRatio												
98th Percentile Output:												
fB%	3.1			1.9	1.9	1.9			1.7			
BOQ	0.5			20.6	19.7	19.4			85.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: North Bridge Street

Inter.: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				462		4		529			658	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas
 Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left		P			SB	Left		
	Thru						Thru	P	
	Right		P				Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		20.0					30.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 670 2009 0.83 0.33 23.0 C 23.0 C

Northbound

T 1026 2051 0.55 0.50 12.4 B 12.4 B

Southbound

T 954 1907 0.80 0.50 15.0 B 15.0 B

Intersection Delay = 16.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				462		4	529			658		
% Heavy Veh				2		2	5			12		
PHF				0.84		0.84	0.93			0.86		
PK 15 Vol				138		1	142			191		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					555		569			765		
%InSharedLn												
Prop LTs					0.991		0.000			0.000		
Prop RTs					0.009		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.373			0.921			0.340		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				462		4	529			658		
PHF				0.84		0.84	0.93			0.86		
Adj flow				550		5	569			765		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					555			569			765	
Prop LTs					0.991			0.000			0.000	
Prop RTs					0.009			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.980			0.952			0.893	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.999			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2009			2051			1907	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	555	2009	# 0.28	0.33	670	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	569	2051	0.28	0.50	1026	0.55
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	765	1907	# 0.40	0.50	954	0.80
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.68
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.81

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.83	0.33	18.4	1.000	670	0.50	4.6	0.0	23.0	C	23.0	C	
Northbound													
T	0.55	0.50	10.4	1.000	1026	0.50	2.0	0.0	12.4	B	12.4	B	
Southbound													
T	0.80	0.50	12.5	1.000	954	0.50	2.5	0.0	15.0	B	15.0	B	

Intersection delay = 16.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.991 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
--	------	------	------	------

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.4	0.00	0.0	0.0	23.0
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	10.4	0.00	0.0	0.0	12.4
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	12.5	0.00	0.0	0.0	15.0
	0.0						0.0	
Intersection Delay			16.6	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		529	262	202	918	
Peak-Hour Factor, PHF		0.93	0.93	0.86	0.86	
Peak-15 Minute Volume		142	70	59	267	
Hourly Flow Rate, HFR		568	281	234	1067	
Percent Heavy Vehicles		--	--	18	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
------------------------	--------	--------	--------	---------	---------	---------

Volume
 Peak Hour Factor, PHF
 Peak-15 Minute Volume
 Hourly Flow Rate, HFR
 Percent Heavy Vehicles
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes
 Configuration

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		18						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3						
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		18						
t(f)		2.4						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)

alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p

	0.000	0.000
--	-------	-------

Computation 3-Platoon Event Periods

	Result
--	--------

p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
--	-----------------------------	-------------------------------------	----------------------------

p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	--------	--------	---------	---------	---------

V c,x	849
s	
Px	
V c,u,x	

C r,x
C plat,x

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	849	
Potential Capacity	724	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	724	
Probability of Queue free St.	0.68	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.68	0.68
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.68	0.68
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L						
v (vph)		234						
C(m) (vph)		724						
v/c		0.32						
95% queue length		1.40						
Control Delay		12.3						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.68
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		12.3
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				134		186	592	105		154	749	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 396 1486 0.96 0.27 56.1 E 56.1 E

Northbound

TR 1098 1937 0.68 0.57 12.0 B 12.0 B

Southbound

LT 652 1150 1.61 0.57 288.5 F 288.5 F

Intersection Delay = 152.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				134		186	592	105		154	749	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				40		55	159	28		45	218	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					381			750			1050	
%InSharedLn												
Prop LTs					0.420			0.000			0.170	
Prop RTs					0.580			0.151			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.901			0.798			0.114		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				134		186	592	105		154	749	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				160		221	637	113		179	871	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					381			750			1050	
Prop LTs					0.420			0.000			0.170	
Prop RTs					0.580			0.151			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.962			0.943	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.984			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.922			0.980			1.000	
fLT					0.979			1.000			0.588	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1486			1937			1150	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	381	1486	# 0.26	0.27	396	0.96
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	750	1937	0.39	0.57	1098	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1050	1150	# 0.91	0.57	652	1.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.17
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.40

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.96	0.27	21.7	1.000	396	0.50	34.4	0.0	56.1	E	56.1	E	
Northbound													
TR	0.68	0.57	9.2	1.000	1098	0.50	2.8	0.0	12.0	B	12.0	B	
Southbound													
LT	1.61	0.57	13.0	1.000	652	0.50	275.5	0.0	288.5	F	288.5	F	

Intersection delay = 152.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			179
Proportion of LT in LT lane group, PLT	0.420	0.000	0.170
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			750
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			2.98
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			12.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			1.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			8.95
gu=g-gq if gq>=gf, or = g-gf if gq<gf			25.05
n=Max(gq-gf)/2,0)			3.90
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.17
EL1 (refer to Exhibit C16-3)			2.94
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.588

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.95
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.263
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				750
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.170
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.580	0.151
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.7	0.00	0.0	0.0	56.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.2	0.00	0.0	0.0	12.0
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	99.5	0.0	288.5
	0.0						0.0	
Intersection Delay			152.8	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

Analyst: ML
 Agency: AECOM
 Date: 08/21/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	96	53	133	35	200	82	90	590	109	151	561	53
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			10		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	31.0				49.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	439	1274	0.73	0.34	31.1	C	31.1	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	564	1636	0.69	0.34	32.3	C	32.3	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	256	470	0.39	0.54	15.2	B		
TR	1067	1959	0.71	0.54	18.4	B	18.1	B

Southbound

LTR	917	1684	0.95	0.54	38.0	D	38.0	D
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 29.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/21/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Richmond Valley Rd & Page Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	96	53	133	35	200	82	90	590	109	151	561	53
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.92	0.91	0.87	0.87	0.87
PK 15 Vol	27	15	38	11	62	25	25	160	30	43	161	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			10
Adj Flow		320			391		99	761			868	
%InSharedLn												
Prop LTS		0.341			0.110		1.000	0.000			0.200	
Prop RTS		0.472			0.258			0.158			0.056	
Peds Bikes	0	0		0	0		0	0	0	0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.503			1.000			0.773			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	96	53	133	35	200	82	90	590	109	151	561	53
PHF	0.88	0.88	0.88	0.81	0.81	0.81	0.91	0.92	0.91	0.87	0.87	0.87
Adj flow	109	60	151	43	247	101	99	641	120	174	645	49
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	320			391			99 761			868		
Prop LTs	0.341			0.110			1.000 0.000			0.200		
Prop RTs	0.472			0.258			0.158			0.056		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	0.990			0.990			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.936			0.965			0.976			0.992		
fLT	0.638			0.936			0.268 1.000			0.538		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1274			1636			470 1959			1684		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	320	1274	# 0.25	0.34	439	0.73
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	391	1636	0.24	0.34	564	0.69
Right							
Northbound							
Prot							
Perm							
Left	L	99	470	0.21	0.54	256	0.39
Prot							
Perm							
Thru	TR	761	1959	0.39	0.54	1067	0.71
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	868	1684	# 0.52	0.54	917	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.77
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.73	0.34	25.8	1.000	439	0.50	5.3	0.0	31.1	C	31.1	C	
Westbound													
LTR	0.69	0.34	25.4	1.000	564	0.50	6.9	0.0	32.3	C	32.3	C	
Northbound													
L	0.39	0.54	11.8	1.000	256	0.50	3.4	0.0	15.2	B			
TR	0.71	0.54	15.3	1.000	1067	0.50	3.2	0.0	18.4	B	18.1	B	
Southbound													
LTR	0.95	0.54	19.3	1.000	917	0.50	18.7	0.0	38.0	D	38.0	D	

Intersection delay = 29.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			99	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.20	
Adjusted opposing flow rate, Vo (veh/h)			868	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.48	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			11.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			8.91	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.09	
n=Max(gq-gf)/2,0)			4.45	
PTHo=1-PLTo			0.80	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.06	
EL2=Max((1-Ptho**n)/Plto, 1.0)			3.15	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			8.91	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.268	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	109	43	174
Proportion of LT in LT lane group, PLT	0.341	0.110	0.000
Proportion of LT in opposing flow, PLTo	0.11	0.34	0.00
Adjusted opposing flow rate, Vo (veh/h)	391	320	761
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	2.73	1.08	4.35
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.77	8.00	19.02
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	1.2	7.6	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	12.94	10.40	25.03
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.06	20.60	23.97
n=Max(gq-gf)/2,0)	5.89	1.40	12.51
PTHo=1-PLTo	0.89	0.66	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.34	0.11	1.00-
EL1 (refer to Exhibit C16-3)	2.06	1.92	2.97
EL2=Max((1-Ptho**n)/Plto, 1.0)	4.52	1.30	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.08
gdifff=max(gq-gf,0)	11.78	2.80	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.94	0.17
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.638	0.936	0.538

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	12.94	10.40	8.91	25.03
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.417	0.336	0.182	0.511
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	391	320	868	761
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.341	0.110	1.000	0.200
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.472	0.258	0.158	0.056
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	29.5	25.8	0.00	0.0	0.0 0.0 0.0	31.1
Westbound								
LTR	0.0 0.0 0.0	0.00	29.5	25.4	0.00	0.0	0.0 0.0 0.0	32.3
Northbound								
L	0.0	0.00	20.5	11.8	0.00	0.0	0.0	15.2
TR	0.0 0.0	0.00	20.5	15.3	0.00	0.0	0.0 0.0	18.4
Southbound								
LTR	0.0 0.0 0.0	0.00	20.5	19.3	0.00	0.0	0.0 0.0 0.0	38.0

Intersection Delay	29.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	320		391		99	761	455	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0		0 1 0		1 1 0		0 2 0	
SL	1274		1636		470	1959	884	
LnCapacity	439		564		256	1067	481	
Flow Ratio	0.3		0.2		0.2	0.4	0.5	
v/c Ratio	0.73		0.69		0.39	0.71	0.95	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.503		1.000			0.773	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.0		8.4		1.4	14.2	10.7	
kB	0.3		0.8		0.3	0.9	0.7	
Q2	0.8		1.6		0.2	2.2	4.7	
Q Average	7.8		10.0		1.6	16.3	15.4	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.3	1.2	1.2	
BOQ	9.6		12.2		2.1	19.7	18.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.4		1.6	1.4	1.4	
BOQ	11.4		14.4		2.7	23.1	21.7	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.9	1.5	1.5	
BOQ	12.6		15.7		3.1	24.8	23.4	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.7		2.3	1.6	1.6	
BOQ	14.2		17.4		3.8	26.8	25.3	
QSRatio								
98th Percentile Output:								
fB%	2.0		1.9		2.8	1.8	1.8	
BOQ	15.8		19.1		4.6	28.7	27.2	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: South Bridge Street

Inter.: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	393						769			694		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left		
	Thru						Thru	P	
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0					50.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	675	2025	0.64	0.33	30.0	C	30.0	C

Westbound

Northbound

T 2156 3880 0.40 0.56 11.8 B 11.8 B

Southbound

T 1990 3582 0.40 0.56 12.0 B 12.0 B

Intersection Delay = 15.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	393						769			694		
% Heavy Veh	1						1			1		
PHF	0.91						0.90			0.87		
PK 15 Vol	108						214			199		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	432						854			798		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.773			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green	30.0						50.0			
Yellow	3.0						3.0			
All Red	2.0						2.0			

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	393						769			694		
PHF	0.91						0.90			0.87		
Adj flow	432						854			798		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	432						854			798		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

Eastbound				Westbound				Northbound				Southbound			
LG	L							T				T			
So	1900							1900				1900			
Lanes	1	0	0	0	0	0	0	2	0	0	0	2	0	0	0
fW	1.133							1.083				1.000			
fHV	0.990							0.990				0.990			
fG	1.000							1.000				1.000			
fP	1.000							1.000				1.000			
fBB	1.000							1.000				1.000			
fA	1.000							1.000				1.000			
fLU	1.000							0.952				0.952			
fRT								1.000				1.000			
fLT	0.950							1.000				1.000			
Sec.															
fLpb	1.000							1.000				1.000			
fRpb								1.000				1.000			
S	2025							3880				3582			
Sec.															

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	432	2025	# 0.21	0.33	675	0.64
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	854	3880	0.22	0.56	2156	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	798	3582	# 0.22	0.56	1990	0.40
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.44$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.49$

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.64	0.33	25.4	1.000	675	0.50	4.6	0.0	30.0	C	30.0	C	
Westbound													
Northbound													
T	0.40	0.56	11.4	1.000	2156	0.50	0.4	0.0	11.8	B	11.8	B	
Southbound													
T	0.40	0.56	11.4	1.000	1990	0.50	0.6	0.0	12.0	B	12.0	B	

Intersection delay = 15.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L						T		T	
Init Queue	0.0						0.0		0.0	
Flow Rate	432						448		419	
So	1900						1900		1900	
No.Lanes	1	0	0	0	0	0	2	0	2	0
SL	2025						2037		1881	
LnCapacity	675						1132		1045	
Flow Ratio	0.2						0.2		0.2	
v/c Ratio	0.64						0.40		0.40	
Grn Ratio	0.33						0.56		0.56	
I Factor		1.000					0.773		0.957	
AT or PVG	3						3		3	
Pltn Ratio	1.00						1.00		1.00	
PF2	1.00						1.00		1.00	
Q1	9.2						6.4		6.0	
kB	0.9						1.0		1.1	
Q2	1.5						0.6		0.7	
Q Average	10.6						7.0		6.7	
Q Spacing	25.0						25.0		25.0	
Q Storage	0						0		0	
Q S Ratio										
70th Percentile Output:										
fB%	1.2						1.2		1.2	
BOQ	12.9						8.6		8.3	
QSRatio										
85th Percentile Output:										
fB%	1.4						1.5		1.5	
BOQ	15.3						10.3		10.0	
QSRatio										
90th Percentile Output:										
fB%	1.6						1.6		1.6	
BOQ	16.6						11.4		11.0	
QSRatio										
95th Percentile Output:										
fB%	1.7						1.8		1.9	
BOQ	18.3						12.9		12.5	
QSRatio										
98th Percentile Output:										
fB%	1.9						2.1		2.1	
BOQ	20.0						14.5		14.1	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					694	
Peak-Hour Factor, PHF					0.87	
Peak-15 Minute Volume					199	
Hourly Flow Rate, HFR					797	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						71
Peak Hour Factor, PHF						0.78
Peak-15 Minute Volume						23
Hourly Flow Rate, HFR						91
Percent Heavy Vehicles						55
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								55
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.8
2-stage								6.8

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								55
t(f)								3.8

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								398
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		398
Potential Capacity		551
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		551
Probability of Queue free St.	1.00	0.83
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	900	401
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	900	401
Probability of Queue free St.	1.00	1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	401	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	401	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	447
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	447

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	683	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity	570	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.83	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						91
Movement Capacity (vph)						551
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						551
Volume						91
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								91
C(m) (vph)								551
v/c								0.17
95% queue length								0.59
Control Delay								12.8
LOS								B
Approach Delay							12.8	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 With-Action Alt 2
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	161	378	210	247	594	87	177	285	150	223	77	106
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
WB	Left	P				SB Left		P	
	Thru	P				Thru		P	
	Right	P				Right		P	
	Peds	X				Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		30.0					25.0	20.0	
Yellow		3.0					3.0	3.0	
All Red		2.0					2.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	115	345	1.59	0.33	322.9	F		
TR	598	1795	1.03	0.33	69.7	E	127.6	F
Westbound								
L	240	696	1.14	0.34	129.7	F		
TR	1145	3323	0.71	0.34	29.3	C	54.5	D
Northbound								
LTR	946	3405	0.67	0.28	32.5	C	32.5	C
Southbound								
L	384	1728	0.76	0.22	45.8	D		
TR	360	1620	0.58	0.22	37.7	D	42.4	D

Intersection Delay = 67.3 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161	378	210	247	594	87	177	285	150	223	77	106
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	46	107	60	69	181	27	48	77	40	73	25	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	183	618		274	817			630		293	208	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.302			0.000	
Prop RTs		0.304			0.114			0.213			0.514	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161	378	210	247	594	87	177	285	150	223	77	106
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	183	430	188	274	724	93	190	306	134	293	101	107
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR		LTR			L	TR	
Adj flow	183	618		274	817		630			293	208	
Prop LTs	1.000	0.000		1.000	0.000		0.302			0.000		
Prop RTs	0.304			0.114			0.213			0.514		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		LTR			L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.954			0.983		0.968				0.923	
fLT	0.190	1.000		0.409*	1.000		0.985			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	345	1795		696	3323		3405			1728	1620	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	183	345	# 0.53	0.33	115	1.59
Prot							
Perm							
Thru	TR	618	1795	0.34	0.33	598	1.03
Right							
Westbound							
Prot							
Perm							
Left	L	274	696	0.39	0.34	240	1.14
Prot							
Perm							
Thru	TR	817	3323	0.25	0.34	1145	0.71
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	630	3405	# 0.19	0.28	946	0.67
Right							
Southbound							
Prot							
Perm							
Left	L	293	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	208	1620	0.13	0.22	360	0.58
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.89
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.59	0.33	30.0	1.000	115	0.50	292.9	0.0	322.9	F		
TR	1.03	0.33	30.0	1.000	598	0.50	39.7	0.0	69.7	E	127.6	F
Westbound												
L	1.14	0.34	29.5	1.000	240	0.50	100.2	0.0	129.7	F		
TR	0.71	0.34	25.6	1.000	1145	0.50	3.6	0.0	29.3	C	54.5	D
Northbound												
LTR	0.67	0.28	28.8	1.000	946	0.50	3.7	0.0	32.5	C	32.5	C
Southbound												
L	0.76	0.22	32.8	1.000	384	0.50	13.0	0.0	45.8	D		
TR	0.58	0.22	31.2	1.000	360	0.50	6.4	0.0	37.7	D	42.4	D

Intersection delay = 67.3 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	183	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	817	618		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	4.58	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.73	15.45		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	13.47	27.37		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.53	3.63		
n=Max(gq-gf)/2,0)	6.73	13.69		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.91	2.32		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.19	0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.190	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.302 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	13.47			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.449			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	817			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.114
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	17.0	0.0	322.9
TR	0.0	0.00	30.0	30.0	0.00	5.0	0.0	69.7
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	8.5	0.0	129.7
TR	0.0	0.00	29.5	25.6	0.00	0.0	0.0	29.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.8	0.00	0.0	0.0	32.5
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.8
TR	0.0	0.00	35.0	31.2	0.00	0.0	0.0	37.7
	0.0						0.0	

Intersection Delay	67.3	sec/veh	Intersection LOS	E
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	183	618		274	429		330			293	208	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	345	1795		696	1745		1788			1728	1620	
LnCapacity	115	598		240	601		496			384	360	
Flow Ratio	0.5	0.3		0.4	0.2		0.2			0.2	0.1	
v/c Ratio	1.59	1.03		1.14	0.71		0.67			0.76	0.58	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.6	15.4		6.8	9.3		7.3			6.9	4.6	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	9.0	7.9		6.4	1.8		1.3			1.6	0.7	
Q Average	13.5	23.4		13.2	11.1		8.6			8.5	5.4	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	16.3	28.1		16.0	13.4		10.5			10.3	6.6	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.5			1.5	1.5	
BOQ	19.2	32.8		18.8	15.9		12.5			12.3	8.0	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.5	1.6		1.6			1.6	1.7	
BOQ	20.7	35.2		20.3	17.2		13.7			13.5	8.9	
QSRatio												
95th Percentile Output:												
fB%	1.7	1.6		1.7	1.7		1.8			1.8	1.9	
BOQ	22.5	37.6		22.1	18.9		15.3			15.1	10.4	
QSRatio												
98th Percentile Output:												
fB%	1.8	1.7		1.8	1.9		2.0			2.0	2.2	
BOQ	24.3	40.1		23.9	20.6		17.0			16.7	11.9	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						534		
Peak-Hour Factor, PHF						0.89		
Hourly Flow Rate, HFR						600		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		407						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		437						
Percent Heavy Vehicles		3						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			437						
C(m) (vph)			462						
v/c			0.95						
95% queue length			11.33						
Control Delay			59.5						
LOS			F						
Approach Delay				59.5					
Approach LOS				F					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: KWVP WB OR UT & No Bridge St
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: KWVP WB Off-Ramp U-Turn
North/South Street: North Bridge Street
Intersection Orientation: NS

Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					534	
Peak-Hour Factor, PHF					0.89	
Peak-15 Minute Volume					150	
Hourly Flow Rate, HFR					600	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	407					
Peak Hour Factor, PHF	0.93					
Peak-15 Minute Volume	109					
Hourly Flow Rate, HFR	437					
Percent Heavy Vehicles	3					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			600					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	600	
Potential Capacity	462	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	462	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 600
Potential Capacity 462
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 462

Results for Two-stage process:
a
y
C t 462

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	437					
Movement Capacity (vph)	462					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	462					
Volume	437					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			437					
C(m) (vph)			462					
v/c			0.95					
95% queue length			11.33					
Control Delay			59.5					
LOS			F					
Approach Delay				59.5				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	14	161	55	147	206	165	16	39	69	80	193	60
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.87	0.87	0.91	0.91	0.76	0.76	1.00	1.00
Flow Rate	107	156	274	294	72	90	176	157
% Heavy Veh	7	7	1	1	1	1	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	107	156	274	294	72	90	176	157
Left-Turn	16	0	161	0	21	0	80	0
Right-Turn	0	63	0	181	0	90	0	60
Prop. Left-Turns	0.1	0.0	0.6	0.0	0.3	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.4	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.2	-0.2	0.3	-0.4	0.2	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	107	156	274	294	72	90	176	157
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.10	0.14	0.24	0.26	0.06	0.08	0.16	0.14
hd, final value	7.05	6.69	6.75	6.03	7.44	6.59	7.18	6.69
x, final value	0.21	0.29	0.51	0.49	0.15	0.16	0.35	0.29
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	4.8	4.4	4.5	3.7	5.1	4.3	4.9	4.4

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	107	156	274	294	72	90	176	157
Service Time	4.8	4.4	4.5	3.7	5.1	4.3	4.9	4.4
Utilization, x	0.21	0.29	0.51	0.49	0.15	0.16	0.35	0.29
Dep. headway, hd	7.05	6.69	6.75	6.03	7.44	6.59	7.18	6.69
Capacity	357	406	522	544	322	340	426	407
Delay	11.61	12.10	16.38	14.43	11.43	10.59	13.72	12.12
LOS	B	B	C	B	B	B	B	B
Approach:								
Delay	11.90		15.37		10.96		12.97	
LOS	B		C		B		B	
Intersection Delay	13.54		Intersection LOS		B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	53	171	504	239	525	10	286	145	124	21	532	123
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	809	3167	1.02	0.26	69.0	E	69.0	E
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	891	3486	1.06	0.26	79.3	E	79.3	E
-----	-----	------	------	------	------	---	------	---

Northbound

DefL	146	452	2.11	0.32	552.2	F		
TR	583	1810	0.50	0.32	27.6	C	298.3	F

Southbound

LTR	956	2968	0.75	0.32	32.7	C	32.7	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 108.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	53	171	504	239	525	10	286	145	124	21	532	123
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	15	49	143	73	160	3	77	39	33	6	141	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		827			943		308	289			719	
%InSharedLn												
Prop LTs		0.073			0.309		1.000	0.000			0.031	
Prop RTs		0.693			0.013			0.460			0.182	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	53	171	504	239	525	10	286	145	124	21	532	123
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	60	194	573	291	640	12	308	156	133	22	566	131
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	827			943			308 289			719		
Prop LTs	0.073			0.309			1.000 0.000			0.031		
Prop RTs	0.693			0.013			0.460			0.182		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	2	0	0	2	0	0	0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.980			0.990 0.990			0.980		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.896			0.998			0.931			0.973		
fLT	0.996			0.985			0.233 1.000			0.939		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3167			3486			452 1810			2968		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	827	3167	# 0.26	0.26	809	1.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	943	3486	# 0.27	0.26	891	1.06
Right							
Northbound							
Prot							
Perm							
Left	DefL	308	452	# 0.68	0.32	146	2.11
Prot							
Perm							
Thru	TR	289	1810	0.16	0.32	583	0.50
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	719	2968	0.24	0.32	956	0.75
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.21
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.46

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	1.02	0.26	33.5	1.000	809	0.50	35.5	0.0	69.0	E	69.0	E	
Westbound													
LTR	1.06	0.26	33.5	1.000	891	0.50	45.8	0.0	79.3	E	79.3	E	
Northbound													
DefL	2.11	0.32	30.5	1.000	146	0.50	521.7	0.0	552.2	F			
TR	0.50	0.32	24.6	1.000	583	0.50	3.0	0.0	27.6	C	298.3	F	
Southbound													
LTR	0.75	0.32	27.3	1.000	956	0.50	5.4	0.0	32.7	C	32.7	C	

Intersection delay = 108.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			308	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			719	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			7.70	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.44	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			11.19	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			17.81	
n=Max(gq-gf)/2,0)			5.60	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.64	
EL2=Max((1-Ptho*n)/Plto, 1.0)			5.22	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			11.19	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.23	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.233	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	22
Proportion of LT in LT lane group, PLT	0.073 0.309 0.000 0.031
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	289
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.55
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	3.61
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	11.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	0.32
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.67
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.07
EL1 (refer to Exhibit C16-3)	1.86
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.939

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				0.32
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.011
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				289
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.031
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.693	0.013	0.460
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	33.5	33.5	0.00	4.5	0.0 0.0 0.0	69.0
Westbound								
LTR	0.0 0.0 0.0	0.00	33.5	33.5	0.00	13.0	0.0 0.0 0.0	79.3
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	40.5	0.0	552.2
TR	0.0 0.0	0.00	30.5	24.6	0.00	0.0	0.0 0.0	27.6
Southbound								
LTR	0.0 0.0 0.0	0.00	30.5	27.3	0.00	0.0	0.0 0.0 0.0	32.7
Intersection Delay			108.0	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	434		495		308	289	377	
So	1900		1900		1900	1900	1900	
No.Lanes	0 2 0	0 0	2 0	0 0	0 2 0		0 2 0	
SL	1663		1830		452	1810	1558	
LnCapacity	424		467		146	583	502	
Flow Ratio	0.3		0.3		0.7	0.2	0.2	
v/c Ratio	1.02		1.06		2.11	0.50	0.75	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.884		0.927			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	10.9		12.4		7.7	5.8	8.4	
kB	0.6		0.6		0.3	0.8	0.7	
Q2	6.1		8.2		20.8	0.8	1.9	
Q Average	17.0		20.6		28.5	6.6	10.3	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	20.5		24.7		34.2	8.1	12.5	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.5	1.4	
BOQ	24.0		28.9		39.9	9.7	14.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.6	
BOQ	25.8		31.0		42.8	10.8	16.1	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.6		1.6	1.9	1.7	
BOQ	27.8		33.2		45.7	12.3	17.8	
QSRatio								
98th Percentile Output:								
fB%	1.8		1.7		1.7	2.1	1.9	
BOQ	29.7		35.5		48.6	13.8	19.5	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue

Inter.: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT R		LTR			L	LT R	
Volume	761	395	4	3	404	868	2	3	2	151	0	288
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds			
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right			
Green	33.0	28.0			14.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	776	1728	1.09	0.73	74.7	E		
TR	1206	1644	0.37	0.73	5.0	A	50.8	D
Westbound								
LT	584	1876	0.73	0.31	32.9	C	292.2	F
R	497	1599	1.84	0.31	413.7	F		
Northbound								
LTR	148	952	0.11	0.16	34.2	C	34.2	C
Southbound								
L	204	1310	0.93	0.16	83.8	F		
LT	283	1818	0.00	0.16	32.1	C	36.8	D
R	862	1492	0.42	0.58	12.1	B		

Intersection Delay = 149.6 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	761	395	4	3	404	868	2	3	2	151	0	288
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
PK 15 Vol	211	110	1	1	106	228	1	2	1	47	0	90
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	846	443			428	914		17		189	0	360
%InSharedLn										0		
Prop LTs	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTs		0.009			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase	0.0											
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.687		0.650			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	
	Thru	P		P				Thru	P	
	Right	P		P				Right	P	
	Peds	X		X				Peds		
WB	Left			P			SB	Left	P	
	Thru			P				Thru	P	
	Right			P				Right	P	
	Peds							Peds		
NB	Right						EB	Right		
SB	Right	P					WB	Right		
Green		33.0	28.0					14.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	761	395	4	3	404	868	2	3	2	151	0	288
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
Adj flow	846	439	4	3	425	914	5	7	5	189	0	360
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
Lane group	L	TR			LT	R		LTR		L	LT	R
Adj flow	846	443			428	914		17		189	0	360
Prop LTs	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTs		0.009			0.000	1.000		0.294			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		LT	R		LTR			L	LT	R
So	1900	1900		1900	1900		1900			1900	1900	1900
Lanes	1	1	0	1	1	0	1	0		1	1	1
fW	0.967	1.000		1.000	1.000		1.133			0.933	0.967	0.933
fHV	0.990	0.990		0.990	0.990		0.990			0.990	0.990	0.990
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fP	1.000	0.875		1.000	1.000		1.000			1.000	1.000	1.000
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fLU	1.000	1.000		1.000	1.000		1.000			1.000	1.000	1.000
fRT		0.999		1.000	0.850		0.960				1.000	0.850
fLT	0.950	1.000		0.997			0.465			0.746	1.000	
Sec.	0.212											
fLpb	1.000	1.000		1.000			1.000			1.000	1.000	
fRpb		1.000		1.000	1.000		1.000				1.000	1.000
S	1728	1644		1876	1599		952			1310	1818	1492
Sec.	386											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		634	1728	# 0.37	0.367	634	1.00
Perm		212	386	0.55	0.367	142	1.49
Left	L	846			0.73	776	1.09
Prot							
Perm							
Thru	TR	443	1644	0.27	0.73	1206	0.37
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	428	1876	0.23	0.31	584	0.73
Right	R	914	1599	# 0.57	0.31	497	1.84
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	952	0.02	0.16	148	0.11
Right							
Southbound							
Prot							
Perm							
Left	L	189	1310	# 0.14	0.16	204	0.93
Prot							
Perm							
Thru	LT	0	1818	0.00	0.16	283	0.00
Right	R	360	1492	0.24	0.58	862	0.42

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.08$
Total lost time per cycle, $L = 15.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.30$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.09	0.73	19.9	1.000	776	0.50	54.8	0.0	74.7	E		
TR	0.37	0.73	4.4	1.000	1206	0.50	0.6	0.0	5.0	A	50.8	D
Westbound												
LT	0.73	0.31	27.7	1.000	584	0.50	5.3	0.0	32.9	C	292.2	F
R	1.84	0.31	31.0	1.000	497	0.50	382.7	0.0	413.7	F		
Northbound												
LTR	0.11	0.16	32.7	1.000	148	0.50	1.6	0.0	34.2	C	34.2	C
Southbound												
L	0.93	0.16	37.5	1.000	204	0.50	46.3	0.0	83.8	F		
LT	0.00	0.16	32.1	1.000	283	0.50	0.0	0.0	32.1	C	36.8	D

R 0.42 0.58 10.6 1.000 862 0.50 1.5 0.0 12.1 B

Intersection delay = 149.6 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	66.0			14.0
Effective permitted green time for LT lane group, g(s)	33.0			14.0
Opposing effective green time, go (s)	28.0			14.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	846			189
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	428			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.15			4.72
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.70			0.43
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69			0.84
gq, (see Exhibit C16-4,5,6,7,8)	19.34			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.66			14.00
n=Max(gq-gf)/2,0)	9.67			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.95			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	9.38			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.12			0.29
gdifff=max(gq-gf,0)	19.34			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.21			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.212			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		28.0	14.0	14.0
Effective permitted green time for LT lane group, g(s)		28.0	14.0	14.0
Opposing effective green time, go (s)		66.0	14.0	14.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.007	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	443	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.07	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	19.4	6.5	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.27	0.84	0.84
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.60	7.52	14.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.17	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.18	0.14
gdif=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.47	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.465	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		28.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		443		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.007		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		
Permitted Right Turns				
Effective pedestrian green time, gp (s)	66.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Conflicting bicycle volume, Vbic (bicycles/h)	0			
Vpedg	0			
OCCpedg	0.000			
Effective green, g (s)	66.0			
Vbicg	0			

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.009
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	846			
v/c ratio from Capacity Worksheet, X	1.09			
Protected phase effective green interval, g (s)	33.0			
Opposing queue effective green interval, gq	19.34			
Unopposed green interval, gu	13.66			
Red time r=(C-g-gq-gu)	24.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.22			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.26			
XPerm	2.01			
XProt	0.78			
Case	3			
Queue at beginning of green arrow, Qa	8.75			
Queue at beginning of unsaturated green, Qu	4.17			
Residual queue, Qr	3.58			
Uniform Delay, d1	19.9			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		19.9	0.00	17.5	0.0	74.7
TR	0.0	0.00	12.0	4.4	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	31.0	27.7	0.00	0.0	0.0	32.9
R	0.0	0.00	31.0	31.0	0.00	104.3	0.0	413.7
Northbound								
	0.0						0.0	
LTR	0.0	0.00	38.0	32.7	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
L	0.0	0.00	38.0	37.5	0.00	0.0	0.0	83.8
LT	0.0	0.00	38.0	32.1	0.00	0.0	0.0	32.1
R	0.0	0.00	19.0	10.6	0.00	0.0	0.0	12.1

Intersection Delay	149.6	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	846	443		428	914		17	189	0	360
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1057	1644		1876	1599		952	1310	1818	1492
LnCapacity	776	1206		584	497		148	204	283	862
Flow Ratio	0.8	0.3		0.2	0.6		0.0	0.1	0.0	0.2
v/c Ratio	1.09	0.37		0.73	1.84		0.11	0.93	0.00	0.42
Grn Ratio	0.73	0.73		0.31	0.31		0.16	0.16	0.16	0.58
I Factor		0.687		0.650			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
Q1	8.9	4.0		9.5	22.9		0.4	4.7	0.0	5.0
kB	0.7	0.9		0.5	0.5		0.3	0.4	0.5	1.0
Q2	13.8	0.5		1.3	53.1		0.0	2.2	0.0	0.7
Q Average	22.7	4.6		10.9	76.0		0.4	6.8	0.0	5.7
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2	1.2		1.3	1.2	1.3	1.2
BOQ	27.3	5.7		13.2	91.1		0.5	8.4	0.0	7.1
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4	1.4		1.7	1.5	1.7	1.5
BOQ	31.8	6.9		15.6	106		0.7	10.1	0.0	8.6
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.6	1.5		2.0	1.6	2.0	1.7
BOQ	34.2	7.8		16.9	114		0.8	11.1	0.0	9.5
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7	1.6		2.5	1.9	2.6	1.9
BOQ	36.5	9.1		18.6	122		1.0	12.7	0.0	11.0
QSRatio										
98th Percentile Output:										
fB%	1.7	2.3		1.9	1.7		3.1	2.1	3.2	2.2
BOQ	38.9	10.5		20.3	129		1.2	14.2	0.0	12.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/9/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2020 With-Action Alt 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0						35.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	753	1506	0.76	0.50	24.8	C		
TR	1066	2132	0.04	0.50	11.5	B	24.0	C

LTR	1561	3122	0.05	0.50	11.6	B	11.6	B
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LTR	1220	3136	0.01	0.39	16.9	B	16.9	B
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LT	548	1410	0.12	0.39	18.1	B	297.7	F
R	616	1583	1.63	0.39	316.4	F		

Intersection Delay = 188.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
PK 15 Vol	143	10	0	1	9	11	2	2	1	16	1	329
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294
Adj Flow	571	40			74			16			67	1002
%InSharedLn												
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.952		1.000			1.000			0.937		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	514	36	0	1	36	43	3	3	2	62	1	1236
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	571	40	0	1	38	35	6	6	4	66	1	1002
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	571	40			74			16			67	1002
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.980	0.980
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.929			0.962			1.000	0.850
fLT	0.706	1.000		0.954			0.910			0.757	
Sec.											
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	1506	2132		3122			3136			1410	1583
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	571	1506	# 0.38	0.50	753	0.76
Prot							
Perm							
Thru	TR	40	2132	0.02	0.50	1066	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	74	3122	0.02	0.50	1561	0.05
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	3136	0.01	0.39	1220	0.01
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	67	1410	0.05	0.39	548	0.12
Right	R	1002	1583	# 0.63	0.39	616	1.63

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.01$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.14$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
DefL	0.76	0.50	18.1	1.000	753	0.50	6.7	0.0	24.8	C		
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	24.0	C
Westbound												
LTR	0.05	0.50	11.5	1.000	1561	0.50	0.1	0.0	11.6	B	11.6	B
Northbound												
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B
Southbound												
LT	0.12	0.39	17.6	1.000	548	0.50	0.4	0.0	18.1	B	297.7	F

R 1.63 0.39 27.5 1.000 616 0.50 288.9 0.0 316.4 F

Intersection delay = 188.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	571			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	74			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	14.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.42			
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.706			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	66	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.985
Proportion of LT in opposing flow, PLTo	0.00	0.99	0.38	
Adjusted opposing flow rate, Vo (veh/h)	40	67	16	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.65	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	1.67	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	37.3	22.9	4.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.73	12.09	30.10	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.01	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.99	
EL1 (refer to Exhibit C16-3)	1.44	1.48	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.05	0.10	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.757	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	74	40	67	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.473	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	18.1	0.00	0.0	0.0	24.8
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.1
R	0.0	0.00	27.5	27.5	0.00	96.5	0.0	316.4
Intersection Delay			188.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			LTR			LT	R
Init Queue	0.0	0.0			0.0			0.0			0.0	0.0
Flow Rate	571	40			38			8			67	1002
So	1900	1900			1900			1900			1900	1900
No.Lanes	0	2	0	0	2	0	0	2	0	0	1	1
SL	1506	2132			1639			1647			1410	1583
LnCapacity	753	1066			819			640			548	616
Flow Ratio	0.4	0.0			0.0			0.0			0.0	0.6
v/c Ratio	0.76	0.04			0.05			0.01			0.12	1.63
Grn Ratio	0.50	0.50			0.50			0.39			0.39	0.39
I Factor		0.952			1.000			1.000			0.937	
AT or PVG	3	3			3			3			3	3
Pltn Ratio	1.00	1.00			1.00			1.00			1.00	1.00
PF2	1.00	1.00			1.00			1.00			1.00	1.00
Q1	11.5	0.5			0.5			0.1			1.1	25.0
kB	0.9	1.1			1.0			0.8			0.7	0.8
Q2	2.5	0.0			0.0			0.0			0.1	50.2
Q Average	14.0	0.6			0.5			0.1			1.2	75.2
Q Spacing	25.0	25.0			25.0			25.0			25.0	25.0
Q Storage	0	0			0			0			0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3			1.3	1.2
BOQ	16.9	0.7			0.7			0.2			1.5	90.2
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.7			1.7			1.6	1.4
BOQ	19.9	0.9			0.9			0.2			1.9	105
QSRatio												
90th Percentile Output:												
fB%	1.5	1.9			1.9			2.0			1.9	1.5
BOQ	21.4	1.1			1.0			0.3			2.2	113
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.5			2.6			2.4	1.6
BOQ	23.3	1.4			1.3			0.3			2.8	120
QSRatio												
98th Percentile Output:												
fB%	1.8	3.0			3.0			3.2			2.9	1.7
BOQ	25.1	1.7			1.6			0.4			3.4	128
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road

Inter.: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	286		24				2	313			749	549
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	547	1727	0.60	0.32	22.0	C	21.6	C
R	473	1495	0.04	0.32	14.4	B		
Westbound								

Northbound

LT 1726 3341 0.21 0.52 8.1 A 8.1 A

Southbound

TR 1945 3765 0.73 0.52 13.3 B 13.3 B

Intersection Delay = 13.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	286		24				2	313		749	549	
% Heavy Veh	8		8				1	1		2	2	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
PK 15 Vol	82		7				1	89		206	151	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			6									0
Adj Flow	329		21					358			1426	
%InSharedLn												
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.423	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.974						0.995			0.791	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	286		24				2	313		749	549	
PHF	0.87		0.87				0.88	0.88		0.91	0.91	
Adj flow	329		21				2	356		823	603	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	329		21					358			1426	
Prop LTs								0.006			0.000	
Prop RTs			1.000					0.000			0.423	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	LT	TR	L	R
LG	L	R	L	R	LT	TR	L	R
So	1900	1900			1900	1900		
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983	1.133		
fHV	0.926	0.926			0.990	0.980		
fG	1.000	1.000			1.000	1.000		
fP	1.000	1.000			1.000	1.000		
fBB	1.000	1.000			1.000	1.000		
fA	1.000	1.000			1.000	1.000		
fLU	1.000	1.000			0.952	0.952		
fRT		0.850			1.000	0.937		
fLT	0.950				0.949	1.000		
Sec.								
fLpb	1.000				1.000	1.000		
fRpb		1.000			1.000	1.000		
S	1727	1495			3341	3765		
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	329	1727	# 0.19	0.32	547	0.60
Prot							
Perm							
Thru							
Right	R	21	1495	0.01	0.32	473	0.04
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	358	3341	0.11	0.52	1726	0.21
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1426	3765	# 0.38	0.52	1945	0.73
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.68

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.60	0.32	17.3	1.000	547	0.50	4.7	0.0	22.0	C	21.6	C
R	0.04	0.32	14.2	1.000	473	0.50	0.2	0.0	14.4	B		
Westbound												
Northbound												
LT	0.21	0.52	7.8	1.000	1726	0.50	0.3	0.0	8.1	A	8.1	A
Southbound												
TR	0.73	0.52	11.3	1.000	1945	0.50	2.0	0.0	13.3	B	13.3	B

Intersection delay = 13.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo			0.952	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	2
Proportion of LT in LT lane group, PLT	0.006 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1426
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.03
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.48
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	15.66
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.30
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	5.98
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.949

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			15.66	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.505	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1426	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.006	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.423
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	17.3	0.00	0.0	0.0	22.0
	0.0						0.0	
R	0.0	0.00	20.5	14.2	0.00	0.0	0.0	14.4
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	7.8	0.00	0.0	0.0	8.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	11.3	0.00	0.0	0.0	13.3
	0.0						0.0	
Intersection Delay			13.8	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	329	21				188		748	
So	1900	1900				1900		1900	
No.Lanes	1 0	1 0	0 0 0			2 0	0	2 0	
SL	1727	1495				1754		1977	
LnCapacity	547	473				906		1021	
Flow Ratio	0.2	0.0				0.1		0.4	
v/c Ratio	0.60	0.04				0.21		0.73	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.974				0.995		0.791	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	4.6	0.2				1.7		9.7	
kB	0.5	0.5				0.8		0.7	
Q2	0.8	0.0				0.2		1.8	
Q Average	5.4	0.3				1.9		11.5	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	6.7	0.3				2.4		13.9	
QSRatio									
85th Percentile Output:									
fB%	1.5	1.7				1.6		1.4	
BOQ	8.2	0.4				3.1		16.4	
QSRatio									
90th Percentile Output:									
fB%	1.7	2.0				1.8		1.6	
BOQ	9.1	0.5				3.5		17.8	
QSRatio									
95th Percentile Output:									
fB%	1.9	2.5				2.3		1.7	
BOQ	10.5	0.7				4.3		19.5	
QSRatio									
98th Percentile Output:									
fB%	2.2	3.1				2.7		1.9	
BOQ	12.0	0.8				5.2		21.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Volume	1	0		518	2		4			23	781	4
Lane Width	12.0			13.0	13.0		10.0				11.0	
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.00	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	601	1442	0.48	0.42	15.5	B		
LT	577	1386	0.51	0.42	16.1	B	15.8	B

Northbound

L	179	430	0.03	0.42	10.6	B	10.6	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2060	4943	0.43	0.42	13.1	B	13.1	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 14.2 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		518	2		4			23	781	4
% Heavy Veh	1	1		3	3		1			1	1	1
PHF	0.50	0.25		0.89	0.89		0.88			0.91	0.91	0.91
PK 15 Vol	1	0		146	1		1			6	215	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	2			291	293		5			887		
%InSharedLn				50								
Prop LTs		0.000		1.000	0.993		1.000				0.028	
Prop RTs	0.000			0.000						0.005		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.983			0.988		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right		
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right							Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		518	2		4			23	781	4
PHF	0.50	0.25		0.89	0.89		0.88			0.91	0.91	0.91
Adj flow	2	0		582	2		5			25	858	4
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L LTR					
Adj flow	2			291	293		5			887		
Prop LTs	0.000			1.000 0.993			1.000			0.028		
Prop RTs	0.000			0.000						0.005		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.971 0.971		0.990		0.990	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				0.999	
fLT	1.000		0.757 0.727		0.245		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1442 1386		430		4943	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	2	1881	0.00	0.42	784	0.00
Right							
Westbound							
Prot							
Perm							
Left	L	291	1442	0.20	0.42	601	0.48
Prot							
Perm							
Thru	LT	293	1386	# 0.21	0.42	577	0.51
Right							
Northbound							
Prot							
Perm							
Left	L	5	430	0.01	0.42	179	0.03
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	887	4943	# 0.18	0.42	2060	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.39
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.47

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.00	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B
Westbound												
L	0.48	0.42	12.8	1.000	601	0.50	2.7	0.0	15.5	B		
LT	0.51	0.42	12.9	1.000	577	0.50	3.1	0.0	16.1	B	15.8	B
Northbound												
L	0.03	0.42	10.3	1.000	179	0.50	0.3	0.0	10.6	B	10.6	B
Southbound												
LTR	0.43	0.42	12.4	1.000	2060	0.50	0.7	0.0	13.1	B	13.1	B

Intersection delay = 14.2 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		291	5	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		2	887	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		4.85	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.03	5.43	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	5.12	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	19.88	
n=Max(gq-gf)/2,0)		0.00	2.56	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	3.25	
EL2=Max((1-Ptho*n)/Plto, 1.0)			2.51	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	5.12	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.24	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.757	0.245	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	291		
Proportion of LT in LT lane group, PLT	0.000	0.993	0.028
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)	2		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600		4.85	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.03	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.99	
EL1 (refer to Exhibit C16-3)		1.38	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.16	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.727	

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound			Southbound	
LaneGroup	TR		L	LT	L			LTR	
Init Queue	0.0		0.0	0.0	0.0			0.0	
Flow Rate	2		291	293	5			325	
So	1900		1900	1900	1900			1900	
No.Lanes	0	1	0	1	0	0	0	3	0
SL	1881		1442	1386	430			1814	
LnCapacity	784		601	577	179			756	
Flow Ratio	0.0		0.2	0.2	0.0			0.2	
v/c Ratio	0.00		0.48	0.51	0.03			0.43	
Grn Ratio	0.42		0.42	0.42	0.42			0.42	
I Factor	1.000		0.983		0.988			1.000	
AT or PVG	3		3	3	3			3	
Pltn Ratio	1.00		1.00	1.00	1.00			1.00	
PF2	1.00		1.00	1.00	1.00			1.00	
Q1	0.0		3.5	3.6	0.0			3.8	
kB	0.7		0.6	0.6	0.3			0.7	
Q2	0.0		0.5	0.6	0.0			0.5	
Q Average	0.0		4.1	4.2	0.1			4.4	
Q Spacing	25.0		25.0	25.0	25.0			25.0	
Q Storage	0		0	0	0			0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.2	1.3			1.2	
BOQ	0.0		5.1	5.2	0.1			5.4	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.5	1.7			1.5	
BOQ	0.0		6.3	6.4	0.1			6.7	
QSRatio									
90th Percentile Output:									
fB%	2.0		1.7	1.7	2.0			1.7	
BOQ	0.0		7.0	7.2	0.1			7.5	
QSRatio									
95th Percentile Output:									
fB%	2.6		2.0	2.0	2.6			2.0	
BOQ	0.1		8.4	8.5	0.1			8.8	
QSRatio									
98th Percentile Output:									
fB%	3.2		2.4	2.3	3.2			2.3	
BOQ	0.1		9.7	9.9	0.2			10.2	
QSRatio									

ERROR MESSAGES

No errors to report.

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Englewood Ave & Vets Rd W RT
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Englewood Avenue
North/South Street: Veterans Rd W Right Turn Bay
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1 L	2 T	3 R	4 L	5 T	6 R
Volume			23				
Peak-Hour Factor, PHF			0.71				
Hourly Flow Rate, HFR			32				
Percent Heavy Vehicles			--	--		--	--
Median Type/Storage		Undivided			/		
RT Channelized?							
Lanes			1				
Configuration			T				
Upstream Signal?			No			No	

Minor Street: Approach Movement	Northbound			Southbound		
	7 L	8 T	9 R	10 L	11 T	12 R
Volume			594			
Peak Hour Factor, PHF			0.88			
Hourly Flow Rate, HFR			675			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach:	Exists?/Storage			/		/
Lanes			1			
Configuration			R			

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			
v (vph)					675			
C(m) (vph)					1045			
v/c					0.65			
95% queue length					4.94			
Control Delay					14.5			
LOS					B			
Approach Delay				14.5				
Approach LOS				B				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		23				
Peak-Hour Factor, PHF		0.71				
Peak-15 Minute Volume		8				
Hourly Flow Rate, HFR		32				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			594			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			169			
Hourly Flow Rate, HFR			675			
Percent Heavy Vehicles			1			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					1			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					1			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x					32			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	32	
Potential Capacity	1045	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1045	
Probability of Queue free St.	0.35	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.35
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.35
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			675			
Movement Capacity (vph)			1045			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1045			
Volume			675			
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					675			
C(m) (vph)					1045			
v/c					0.65			
95% queue length					4.94			
Control Delay					14.5			
LOS					B			
Approach Delay				14.5				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	125	39	269	94	0	0	0	0	24	89	25
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.80		0.78				0.91 0.91	
Flow Rate	204		464				74 76	
% Heavy Veh	2		3				1 1	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	204		464				74	76
Left-Turn	0		344				26	0
Right-Turn	48		0				0	27
Prop. Left-Turns	0.0		0.7				0.4	0.0
Prop. Right-Turns	0.2		0.0				0.0	0.4
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Weekday 5-6 PM Peak Period
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	39	110	0	0	298	19	65	100	141	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.80		0.78		0.99		0.99	
Flow Rate	185		406		115		192	
% Heavy Veh	2		5		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	185		406		115	192		
Left-Turn	48		0		65	0		
Right-Turn	0		24		0	142		
Prop. Left-Turns	0.3		0.0		0.6	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

hRT-adj	-0.6	-0.6	-0.6
hHV-adj	1.7	1.7	1.7
hadj, computed	0.1	0.0	0.1 -0.4

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	185		406		115	192		
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.16		0.36		0.10	0.17		
hd, final value	5.31		4.98		5.54	4.98		
x, final value	0.27		0.56		0.18	0.27		
Move-up time, m		2.0		2.0		2.0		
Service Time	3.3		3.0		3.5	3.0		

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	185		406		115	192		
Service Time	3.3		3.0		3.5	3.0		
Utilization, x	0.27		0.56		0.18	0.27		
Dep. headway, hd	5.31		4.98		5.54	4.98		
Capacity	435		656		365	442		
Delay	10.30		14.17		9.72	9.76		
LOS	B		B		A	A		
Approach:								
Delay		10.30		14.17		9.75		
LOS		B		B		A		
Intersection Delay	11.86							
			Intersection	LOS	B			

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	192	268	158	8	60	9	460	105	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		21.0					29.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	561	1602	0.96	0.35	49.3	D	42.8	D
R	560	1599	0.22	0.35	14.7	B		

Westbound

LTR	527	1506	0.17	0.35	14.1	B	14.1	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2300	4758	0.28	0.48	9.5	A	9.5	A
-----	------	------	------	------	-----	---	-----	---

Southbound

Intersection Delay = 25.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	192	268	158	8	60	9	460	105	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	56	79	46	2	17	3	129	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		541	124		88			637				
%InSharedLn												
Prop LTs		0.418			0.102			0.812				
Prop RTs		0.000	1.000		0.114			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	192	268	158	8	60	9	460	105	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	226	315	124	9	69	10	517	118	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow		541	124		88			637				
Prop LTs		0.418			0.102			0.812				
Prop RTs	0.000	1.000		0.114			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound	
LG	LT	R		LTR			LTR				
So	1900	1900		1900			1900				
Lanes 0	1	1	0	1	0	0	3	0	0	0	0
fW	1.033	1.000		0.983			0.967				
fHV	0.990	0.990		0.990			0.990				
fG	1.000	1.000		1.000			1.000				
fP	1.000	1.000		0.875			1.000				
fBB	1.000	1.000		1.000			1.000				
fA	1.000	1.000		1.000			1.000				
fLU	1.000	1.000		1.000			0.908				
fRT	1.000	0.850		0.985			1.000				
fLT	0.824			0.945			0.961				
Sec.											
fLpb	1.000			1.000			1.000				
fRpb	1.000	1.000		1.000			1.000				
S	1602	1599		1506			4758				
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Table 1. Traffic Volume and Delay Data for the I-75/US-41 Interchange												
Direction		Traffic Volume (V)			Delay (D)			Level of Service (LOS)			Other Metrics	
Phase	Flow	Peak	Off-Peak	Annual	Peak	Off-Peak	Annual	LOS	LOS	LOS	Other	Other
Eastbound												
LT	0.96	0.35	19.1	1.000	561	0.50	30.1	0.0	49.3	D	42.8	D
R	0.22	0.35	13.7	1.000	560	0.50	0.9	0.0	14.7	B		
Westbound												
LTR	0.17	0.35	13.5	1.000	527	0.50	0.7	0.0	14.1	B	14.1	B
Northbound												
LTR	0.28	0.48	9.2	1.000	2300	0.50	0.3	0.0	9.5	A	9.5	A
Southbound												

Intersection delay = 25.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	226	9	
Proportion of LT in LT lane group, PLT	0.418	0.102	0.812
Proportion of LT in opposing flow, PLTo	0.10	0.42	
Adjusted opposing flow rate, Vo (veh/h)	88	541	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.77	0.15	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.47	9.02	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	11.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	11.72	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.00	9.25	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.90	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.10	
EL1 (refer to Exhibit C16-3)	1.51	2.39	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.824	0.945	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	11.72		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.558		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	88	541	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.418	0.102	0.812	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.114	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.1	0.00	0.0	0.0	49.3
R	0.0	0.00	19.5	13.7	0.00	0.0	0.0	14.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.5	0.00	0.0	0.0	14.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.2	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			25.7	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	541	124	88	233			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1602	1599	1506	1746			
LnCapacity	561	560	527	844			
Flow Ratio	0.3	0.1	0.1	0.1			
v/c Ratio	0.96	0.22	0.17	0.28			
Grn Ratio	0.35	0.35	0.35	0.48			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	8.8	1.5	1.0	2.3			
kB	0.6	0.6	0.5	0.7			
Q2	5.1	0.2	0.1	0.3			
Q Average	13.9	1.6	1.1	2.6			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	16.8	2.1	1.4	3.3			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.6			
BOQ	19.8	2.6	1.8	4.1			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.9	1.9	1.8			
BOQ	21.3	3.0	2.1	4.7			
QSRatio							
95th Percentile Output:							
fB%	1.7	2.3	2.4	2.2			
BOQ	23.2	3.8	2.7	5.7			
QSRatio							
98th Percentile Output:							
fB%	1.8	2.8	2.9	2.6			
BOQ	25.0	4.5	3.3	6.7			
QSRatio							

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	236		34				18	467		470	58	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 459 1723 0.61 0.27 25.2 C 25.2 C

Westbound

Northbound

LT 1098 1938 0.51 0.57 9.5 A 9.5 A

Southbound

TR 1124 1983 0.51 0.57 9.4 A 9.4 A

Intersection Delay = 12.6 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	236		34				18	467		470	58	
% Heavy Veh	3		3				1	1		4	4	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
PK 15 Vol	61		9				5	136		128	16	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		281						564			574	
%InSharedLn												
Prop LTs		0.875						0.037			0.000	
Prop RTs		0.125						0.000			0.110	
Peds Bikes	0			0						0		0
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.984						0.880			0.893	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	236		34				18	467		470	58	
PHF	0.96		0.96				0.86	0.86		0.92	0.92	
Adj flow	246		35				21	543		511	63	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		281						564			574	
Prop LTs		0.875						0.037			0.000	
Prop RTs	0.125						0.000			0.110		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.971						0.990			0.962		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.983						1.000			0.985		
fLT	0.958						0.974			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1723						1938			1983		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	281	1723	# 0.16	0.27	459	0.61
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	564	1938	# 0.29	0.57	1098	0.51
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	574	1983	0.29	0.57	1124	0.51
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.45
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.54

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.61	0.27	19.3	1.000	459	0.50	5.9	0.0	25.2	C	25.2	C
Westbound												
Northbound												
LT	0.51	0.57	7.9	1.000	1098	0.50	1.5	0.0	9.5	A	9.5	A
Southbound												
TR	0.51	0.57	7.9	1.000	1124	0.50	1.5	0.0	9.4	A	9.4	A

Intersection delay = 12.6 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		21	
Proportion of LT in LT lane group, PLT	0.875	0.037	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		574	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.35	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.57	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		16.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		6.38	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.20	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.47	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.97	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.974	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			6.38	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.188	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			574	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.037	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.110
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	19.3	0.00	0.0	0.0	25.2
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.9	0.00	0.0	0.0	9.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.9	0.00	0.0	0.0	9.4
	0.0						0.0	
Intersection Delay			12.6	sec/veh	Intersection LOS		B	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	281						564			574		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1723						1938			1983		
LnCapacity	459						1098			1124		
Flow Ratio	0.2						0.3			0.3		
v/c Ratio	0.61						0.51			0.51		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.984						0.880			0.893		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.1						5.7			5.8		
kB	0.5						0.8			0.8		
Q2	0.7						0.8			0.9		
Q Average	4.9						6.6			6.7		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.0						8.1			8.2		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.5			1.5		
BOQ	7.3						9.8			9.9		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.6			1.6		
BOQ	8.2						10.8			10.9		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.9			1.9		
BOQ	9.6						12.3			12.5		
QSRatio												
98th Percentile Output:												
fB%	2.3						2.1			2.1		
BOQ	11.0						13.8			14.0		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	165		86				23	591		417	298	
Lane Width		16.0						16.0		16.0		
RTOR Vol			0								21	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR 574 1723 0.55 0.33 19.7 B 19.7 B

Westbound

Northbound

LT 889 1778 0.80 0.50 19.0 B 19.0 B

Southbound

TR 962 1923 0.78 0.50 18.0 B 18.0 B

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	165		86				23	591		417	298	
% Heavy Veh	1		1				1	1		3	3	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
PK 15 Vol	52		27				7	172		113	81	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									21
Adj Flow		313						714			754	
%InSharedLn												
Prop LTs		0.658						0.038			0.000	
Prop RTs	0.342						0.000			0.399		
Peds Bikes	0	0		0						0	0	
Buses		0						2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.911						0.834			0.880	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	165		86				23	591		417	298	
PHF	0.80		0.80				0.86	0.86		0.92	0.92	
Adj flow	206		107				27	687		453	301	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		313						714			754	
Prop LTs		0.658						0.038			0.000	
Prop RTs		0.342						0.000			0.399	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.971		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						0.992			0.972		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.954						1.000			0.946		
fLT	0.968						0.961			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1723						1778			1923		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	313	1723	# 0.18	0.33	574	0.55
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	714	1778	# 0.40	0.50	889	0.80
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	754	1923	0.39	0.50	962	0.78
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.58
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.55	0.33	16.3	1.000	574	0.50	3.4	0.0	19.7	B	19.7	B
Westbound												
Northbound												
LT	0.80	0.50	12.5	1.000	889	0.50	6.4	0.0	19.0	B	19.0	B
Southbound												
TR	0.78	0.50	12.3	1.000	962	0.50	5.6	0.0	18.0	B	18.0	B

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		27	
Proportion of LT in LT lane group, PLT	0.658	0.038	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		754	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.45	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		12.57	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		12.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		11.30	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.17	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.95	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.96	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.961	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			11.30	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.377	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		754	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.658		0.038	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.342	0.399
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.3	0.00	0.0	0.0	19.7
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	12.5	0.00	0.0	0.0	19.0
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	12.3	0.00	0.0	0.0	18.0
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	313						714			754		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1723						1778			1923		
LnCapacity	574						889			962		
Flow Ratio	0.2						0.4			0.4		
v/c Ratio	0.55						0.80			0.78		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.911						0.834			0.880		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.3						9.9			10.3		
kB	0.5						0.7			0.7		
Q2	0.6						2.4			2.4		
Q Average	4.9						12.4			12.8		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	6.0						14.9			15.4		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	7.4						17.6			18.2		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.5			1.5		
BOQ	8.2						19.1			19.7		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.7			1.7		
BOQ	9.6						20.8			21.4		
QSRatio												
98th Percentile Output:												
fB%	2.3						1.8			1.8		
BOQ	11.0						22.6			23.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		161	282	463	274	99	206		499	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.02	0.13	22.7	C	44.0	D
R	220	1652	0.77	0.13	44.5	D		
Westbound								
LTR	1329	4689	0.87	0.28	24.7	C	24.7	C
Northbound								
L	124	373	0.87	0.33	68.1	E		
T	616	1848	0.36	0.33	16.7	B	33.4	C
Southbound								
TR	670	2010	0.87	0.33	31.2	C	31.2	C

Intersection Delay = 29.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		161	282	463	274	99	206		499	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		42	80	132	78	27	56		143	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		169		1157		108	224			580	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		161	282	463	274	99	206		499	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		169	320	526	311	108	224		574	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	4		169		1157		108	224			580	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.990		0.980	0.980	0.962	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.972	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.960			1.000	0.999	
fLT	0.950		0.986		0.200	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4689		373	1848	2010	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	1668	0.00	0.13	222	0.02
Prot							
Perm							
Thru							
Right	R	169	1652	# 0.10	0.13	220	0.77
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1157	4689	# 0.25	0.28	1329	0.87
Right							
Northbound							
Prot							
Perm							
Left	L	108	373	# 0.29	0.33	124	0.87
Prot							
Perm							
Thru	T	224	1848	0.12	0.33	616	0.36
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	580	2010	0.29	0.33	670	0.87
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
L	0.02	0.13	22.6	1.000	222	0.50	0.1	0.0	22.7	C	44.0	D
R	0.77	0.13	25.1	1.000	220	0.50	19.4	0.0	44.5	D		
Westbound												
LTR	0.87	0.28	20.5	1.000	1329	0.50	4.2	0.0	24.7	C	24.7	C
Northbound												
L	0.87	0.33	18.8	1.000	124	0.50	49.3	0.0	68.1	E	33.4	C
T	0.36	0.33	15.2	1.000	616	0.50	1.5	0.0	16.7	B		
Southbound												
TR	0.87	0.33	18.7	1.000	670	0.50	12.4	0.0	31.2	C	31.2	C

Intersection delay = 29.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			108	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			580	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			1.80	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			9.67	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			13.11	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			6.89	
n=Max(gq-gf)/2,0)			6.56	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.24	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.20	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.200	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			13.11	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.656	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			580	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0			20.0
Conflicting pedestrian volume, Vped (p/h)	0			0
Conflicting bicycle volume, Vbic (bicycles/h)	0			0
Vpedg	0			0
OCCpedg	0.000			0.000
Effective green, g (s)	17.0			20.0
Vbicg	0			0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.269	0.010
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	22.7
	0.0						0.0	
R	0.0	0.00	26.0	25.1	0.00	0.0	0.0	44.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	20.5	0.00	0.0	0.0	24.7
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	18.8	0.00	0.0	0.0	68.1
T	0.0	0.00	20.0	15.2	0.00	0.0	0.0	16.7
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	18.7	0.00	0.0	0.0	31.2
	0.0						0.0	
Intersection Delay			29.2	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	4	169		424		108	224		580
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1721		373	1848		2010
LnCapacity	222	220		487		124	616		670
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.3
v/c Ratio	0.02	0.77		0.87		0.87	0.36		0.87
Grn Ratio	0.13	0.13		0.28		0.33	0.33		0.33
I Factor		0.848		0.500			0.930		0.865
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.1	2.7		6.7		1.7	2.8		9.1
kB	0.3	0.3		0.3		0.2	0.6		0.6
Q2	0.0	0.7		1.5		0.9	0.3		2.9
Q Average	0.1	3.5		8.2		2.6	3.2		11.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.1	4.3		10.0		3.2	4.0		14.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.4
BOQ	0.1	5.4		12.0		4.1	4.9		17.0
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.5
BOQ	0.1	6.1		13.1		4.6	5.6		18.5
QSRatio									
95th Percentile Output:									
fB%	2.6	2.1		1.8		2.2	2.1		1.7
BOQ	0.2	7.3		14.7		5.6	6.7		20.2
QSRatio									
98th Percentile Output:									
fB%	3.2	2.4		2.0		2.6	2.5		1.8
BOQ	0.2	8.5		16.3		6.7	7.9		21.9
QSRatio									

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	10	20	6				9	295	126	317	573	51
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				12

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0					33.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	460	1623	0.13	0.28	16.5	B	16.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LTR	956	1738	0.49	0.55	10.0-	A	10.0-	A
-----	-----	------	------	------	-------	---	-------	---

Southbound

L	491	893	0.69	0.55	14.4	B		
TR	986	1793	0.67	0.55	11.6	B	12.6	B

Intersection Delay = 11.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: S Service Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10	20	6				9	295	126	317	573	51
% Heavy Veh	2	2	2				2	2	2	2	2	2
PHF	0.63	0.63	0.63				0.92	0.92	0.92	0.93	0.93	0.93
PK 15 Vol	4	8	2				3	80	34	85	154	14
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			12
Adj Flow		58						468		341	658	
%InSharedLn												
Prop LTS		0.276						0.021		1.000	0.000	
Prop RTS		0.172						0.293		0.064		
Peds Bikes	0	0		0			0	0		0	0	
Buses		0						2		0	7	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.922			0.564	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	10	20	6						9	295	126		317	573	51
PHF	0.63	0.63	0.63						0.92	0.92	0.92		0.93	0.93	0.93
Adj flow	16	32	10						10	321	137		341	616	42
No. Lanes	0	1	0		0	0	0		0	1	0		1	1	0
Lane group	LTR								LTR				L	TR	
Adj flow		58								468			341	658	
Prop LTs		0.276								0.021			1.000	0.000	
Prop RTs	0.172								0.293				0.064		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW	1.033						1.133			1.000	1.000	
fHV	0.980						0.980			0.980	0.980	
fG	1.000						1.000			1.000	1.000	
fP	0.875						0.875			1.000	1.000	
fBB	1.000						0.992			1.000	0.972	
fA	1.000						1.000			1.000	1.000	
fLU	1.000						1.000			1.000	1.000	
fRT	0.977						0.960				0.990	
fLT	0.986						0.987			0.479	1.000	
Sec.												
fLpb	1.000						1.000			1.000	1.000	
fRpb	1.000						1.000				1.000	
S	1623						1738			893	1793	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	58	1623	# 0.04	0.28	460	0.13
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	468	1738	0.27	0.55	956	0.49
Right							
Southbound							
Prot							
Perm							
Left	L	341	893	# 0.38	0.55	491	0.69
Prot							
Perm							
Thru	TR	658	1793	0.37	0.55	986	0.67
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.50

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.13	0.28	16.0	1.000	460	0.50	0.6	0.0	16.5	B	16.5	B
Westbound												
Northbound												
LTR	0.49	0.55	8.3	1.000	956	0.50	1.7	0.0	10.0-	A	10.0-	A
Southbound												
L	0.69	0.55	9.8	1.000	491	0.50	4.5	0.0	14.4	B		
TR	0.67	0.55	9.6	1.000	986	0.50	2.0	0.0	11.6	B	12.6	B

Intersection delay = 11.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				341
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				468
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.68
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				7.80
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				5.14
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.86
n=Max(gq-gf)/2,0)				2.57
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.02
EL2=Max((1-Ptho**n)/Plto, 1.0)				2.52
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				5.14
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.48
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.479

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No		1
Adjusted LT flow rate, VLT (veh/h)		10
Proportion of LT in LT lane group, PLT	0.276	0.021 0.000
Proportion of LT in opposing flow, PLTo		0.00
Adjusted opposing flow rate, Vo (veh/h)		658
Lost time for LT lane group, tL		5.00
Computation		
LT volume per cycle, LTC=VLTC/3600		0.17
Opposing lane util. factor, fLUo	1.000	1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		10.97
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		20.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.45
gq, (see Exhibit C16-4,5,6,7,8)		8.14
gu=g-gq if gq>=gf, or = g-gf if gq<gf		12.15
n=Max(gq-gf)/2,0)		0.00
PTHo=1-PLTo		1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.02
EL1 (refer to Exhibit C16-3)		2.69
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.06
gdifff=max(gq-gf,0)		0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.99
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT		0.987

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			8.14	5.14
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.247	0.156
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			658	468
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.021	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.172	0.293	0.064
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.0	0.00	0.0	0.0	16.5
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.3	0.00	0.0	0.0	10.0-
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	9.8	0.00	0.0	0.0	14.4
TR	0.0	0.00	13.5	9.6	0.00	0.0	0.0	11.6
	0.0						0.0	

Intersection Delay	11.9	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	58						468			341	658	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1623						1738			893	1793	
LnCapacity	460						956			491	986	
Flow Ratio	0.0						0.3			0.4	0.4	
v/c Ratio	0.13						0.49			0.69	0.67	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.922				0.564	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	0.7						4.8			4.1	7.8	
kB	0.5						0.8			0.3	0.5	
Q2	0.1						0.7			0.6	0.9	
Q Average	0.8						5.5			4.8	8.7	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	1.0						6.8			5.9	10.6	
QSRatio												
85th Percentile Output:												
fB%	1.7						1.5			1.5	1.5	
BOQ	1.3						8.3			7.3	12.7	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.7			1.7	1.6	
BOQ	1.5						9.2			8.1	13.9	
QSRatio												
95th Percentile Output:												
fB%	2.5						1.9			2.0	1.8	
BOQ	1.9						10.7			9.5	15.5	
QSRatio												
98th Percentile Output:												
fB%	3.0						2.2			2.3	2.0	
BOQ	2.4						12.1			10.9	17.1	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	13	20	266	29	109	18	314	174	93	450	10
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 634 1427 0.09 0.44 14.7 B 14.7 B

Westbound

L 560 1259 0.55 0.44 21.8 C
 T 792 1783 0.04 0.44 14.2 B 19.7 B
 R 585 1316 0.21 0.44 16.1 B

Northbound

LTR 732 1648 0.75 0.44 25.6 C 25.6 C

Southbound

LTR 624 1404 1.02 0.44 46.8 D 46.8 D

Intersection Delay = 31.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	13	20	266	29	109	18	314	174	93	450	10
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	5	7	76	8	31	5	85	47	27	129	3
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900	1900	1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol			0			0			0			0
Adj Flow	57			306	33	125	550			635		
%InSharedLn												
Prop LTS		0.158		1.000	0.000			0.036			0.169	
Prop RTS	0.509			0.000	1.000		0.344			0.017		
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0	0.0	0.0			0.0		
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000			0.905			0.663			0.229		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5			11.8			18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	13	20	266	29	109	18	314	174	93	450	10
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	19	29	306	33	125	20	341	189	107	517	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	57			306 33 125			550			635		
Prop LTs	0.158			1.000 0.000			0.036			0.169		
Prop RTs	0.509			0.000 1.000			0.344			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	1	0	0	1	0
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.954		0.998		
fLT	0.976		0.720	1.000		0.969		0.758		
Sec.										
fLpb	1.000		0.948	1.000		1.000		0.996		
fRpb	0.972		1.000 1.000			0.981		1.000		
S	1427		1259	1783	1316	1648		1404		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1427	0.04	0.44	634	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	306	1259	# 0.24	0.44	560	0.55
Prot							
Perm							
Thru	T	33	1783	0.02	0.44	792	0.04
Right	R	125	1316	0.09	0.44	585	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	550	1648	0.33	0.44	732	0.75
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	635	1404	# 0.45	0.44	624	1.02
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.44	14.5	1.000	634	0.50	0.3	0.0	14.7	B	14.7	B
Westbound												
L	0.55	0.44	18.3	1.000	560	0.50	3.4	0.0	21.8	C		
T	0.04	0.44	14.2	1.000	792	0.50	0.1	0.0	14.2	B	19.7	B
R	0.21	0.44	15.3	1.000	585	0.50	0.8	0.0	16.1	B		
Northbound												
LTR	0.75	0.44	20.9	1.000	732	0.50	4.7	0.0	25.6	C	25.6	C
Southbound												
LTR	1.02	0.44	25.0	1.000	624	0.50	21.8	0.0	46.8	D	46.8	D

Intersection delay = 31.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	107
Proportion of LT in LT lane group, PLT	0.158	0.000	0.036
Proportion of LT in opposing flow, PLTo	0.00	0.17	0.04
Adjusted opposing flow rate, Vo (veh/h)	33	635	550
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.82	15.88	13.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.6	17.9	3.1
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	16.78	14.52
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.45	22.06	25.48
n=Max(gq-gf)/2,0)	0.00	0.00	5.71
PTHo=1-PLTo	1.00	0.83	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.17
EL1 (refer to Exhibit C16-3)	1.42	2.63	2.42
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.24
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdif=max(gq-gf,0)	0.00	0.00	11.42
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.976	0.969	0.758

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	16.78	14.52
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.420	0.363
OCCpedu	0.000	0.056	0.000	0.046
Opposing flow rate, Vo (veh/h)	33	57	635	550
OCCr	0.000	0.052	0.000	0.021
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.948	1.000	0.979
Proportion of left turns, PLT	0.158	1.000	0.036	0.169
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.948	1.000	0.996

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.509	1.000	0.344	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.972	1.000	0.981	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	14.5	0.00	0.0	0.0	14.7
	0.0						0.0	
Westbound								
L	0.0	0.00	25.0	18.3	0.00	0.0	0.0	21.8
T	0.0	0.00	25.0	14.2	0.00	0.0	0.0	14.2
R	0.0	0.00	25.0	15.3	0.00	0.0	0.0	16.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	20.9	0.00	0.0	0.0	25.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	25.0	25.0	0.00	2.7	0.0	46.8
	0.0						0.0	

Intersection Delay	31.5	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	LTR		L	T	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0	0.0		0.0	
Flow Rate	57		306	33	125	550		635	
So	1900		1900	1900	1900	1900		1900	
No.Lanes	0	1	0	1	1	0	1	0	0
SL	1427		1259	1783	1316	1648		1404	
LnCapacity	634		560	792	585	732		624	
Flow Ratio	0.0		0.2	0.0	0.1	0.3		0.5	
v/c Ratio	0.09		0.55	0.04	0.21	0.75		1.02	
Grn Ratio	0.44		0.44	0.44	0.44	0.44		0.44	
I Factor	1.000		0.905			0.663		0.229	
AT or PVG	3		3	3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00	1.00		1.00	
Q1	0.8		5.6	0.5	1.9	11.5		15.9	
kB	0.8		0.7	0.9	0.7	0.6		0.2	
Q2	0.1		0.8	0.0	0.2	1.7		4.6	
Q Average	0.9		6.4	0.5	2.1	13.2		20.5	
Q Spacing	25.0		25.0	25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3		1.2	1.3	1.3	1.2		1.2	
BOQ	1.2		7.9	0.7	2.7	15.9		24.6	
QSRatio									
85th Percentile Output:									
fB%	1.7		1.5	1.7	1.6	1.4		1.4	
BOQ	1.5		9.5	0.8	3.4	18.7		28.8	
QSRatio									
90th Percentile Output:									
fB%	1.9		1.6	2.0	1.8	1.5		1.5	
BOQ	1.7		10.5	1.0	3.9	20.2		30.9	
QSRatio									
95th Percentile Output:									
fB%	2.4		1.9	2.5	2.3	1.7		1.6	
BOQ	2.2		12.1	1.3	4.8	22.0		33.1	
QSRatio									
98th Percentile Output:									
fB%	3.0		2.1	3.1	2.7	1.8		1.7	
BOQ	2.7		13.6	1.5	5.7	23.8		35.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	210		252	227	231		158		217			
Lane Width	16.0			16.0			11.0					
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0				35.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	940	1880	0.52	0.50	17.2	B	17.2	B
----	-----	------	------	------	------	---	------	---

Westbound

LT	461	922	1.20	0.50	129.7	F	129.7	F
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Northbound

LR	559	1437	1.00	0.39	64.4	E	64.4	E
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Southbound

Intersection Delay = 72.4 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		210	252	227	231		158		217			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		64	77	68	70		59		81			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			59						0			
Adj Flow		491			551			560				
%InSharedLn												
Prop LTs		0.000			0.495			0.421				
Prop RTs		0.479			0.000			0.579				
Peds Bikes		0						0		0		
Buses		5			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		210	252	227	231		158		217			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		256	235	273	278		236		324			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		491			551			560				
Prop LTs		0.000			0.495			0.421				
Prop RTs		0.479			0.000			0.579				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.952			0.926			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.980			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.935			1.000			0.922					
fLT	1.000			0.462			0.979					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1880			922			1437					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.52	0.50	15.2	1.000	940	0.50	1.9	0.0	17.2	B	17.2	B
Westbound												
LT	1.20	0.50	22.5	1.000	461	0.50	107.2	0.0	129.7	F	129.7	F
Northbound												
LR	1.00	0.39	27.5	1.000	559	0.50	36.9	0.0	64.4	E	64.4	E
Southbound												

Intersection delay = 72.4 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	273		
Proportion of LT in LT lane group, PLT	0.000	0.495	0.421
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	491		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	6.83		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.27		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	11.01		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	33.99		
n=Max(gq-gf)/2,0)	5.51		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.50		
EL1 (refer to Exhibit C16-3)	2.28		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.46		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.462		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	15.2	0.00	0.0	0.0	17.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	22.5	0.00	22.5	0.0	129.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	27.5	0.00	0.2	0.0	64.4
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			72.4	sec/veh	Intersection LOS E			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		491			551			560				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1880			922			1437				
LnCapacity		940			461			559				
Flow Ratio		0.3			0.6			0.4				
v/c Ratio		0.52			1.20			1.00				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.989			0.917				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		8.3			13.8			14.0				
kB		1.0			0.7			0.7				
Q2		1.1			14.4			7.0				
Q Average		9.4			28.2			21.0				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		11.4			33.8			25.3				
QSRatio												
85th Percentile Output:												
fB%		1.4			1.4			1.4				
BOQ		13.6			39.5			29.6				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.5				
BOQ		14.8			42.3			31.7				
QSRatio												
95th Percentile Output:												
fB%		1.8			1.6			1.6				
BOQ		16.5			45.2			34.0				
QSRatio												
98th Percentile Output:												
fB%		1.9			1.7			1.7				
BOQ		18.1			48.0			36.2				
QSRatio												

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Sharrotts Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig	LTR			LTR			LTR			LTR		
Volume	27	33	24	68	17	41	12	291	64	29	340	28
Lane Width	16.0			16.0			16.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left		P			NB Left	P		
	Thru		P			Thru	P		
	Right		P			Right	P		
	Peds		X			Peds	X		
WB	Left	P				SB Left	P		
	Thru	P				Thru	P		
	Right	P				Right	P		
	Peds					Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		15.0	7.0				23.0	0.0	
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 238 2037 0.88 0.12 59.8 E 59.8 E

Westbound

LTR 501 2004 0.32 0.25 20.1 C 20.1 C

Northbound

LTR 762 1987 0.52 0.38 16.8 B 16.8 B

Southbound

LTR 735 1917 0.61 0.38 18.7 B 18.7 B

Intersection Delay = 25.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 Peak Pd
 Intersection: Sharrotts Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	27	33	24	68	17	41	12	291	64	29	340	28
% Heavy Veh	0	0	0	0	0	0	3	3	3	5	5	5
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
PK 15 Vol	17	21	15	22	5	13	3	79	17	8	97	8
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900			1900			1900	
ParkExist												
NumPark												
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
LGConfig		LTR			LTR			LTR			LTR	
Lane Width		16.0			16.0			16.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		209			162			399			451	
%InSharedLn												
Prop LTs		0.321			0.537			0.033			0.073	
Prop RTs		0.287			0.327			0.175			0.071	
Peds Bikes	0	0		0			0	0		0		
Buses		0			0			2			2	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0			0.0	
Arriv. Type		3			3			3			3	
Unit Ext.		3.0			3.0			3.0			3.0	
I Factor		1.000			1.000			1.000			1.000	
Lost Time		2.0			2.0			2.0			2.0	
Ext of g		2.0			2.0			2.0			2.0	
Ped Min g		3.2			3.2			3.2			3.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left		P			NB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		15.0	7.0					23.0	0.0
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	27	33	24	68	17	41	12	291	64	29	340	28
PHF	0.40	0.40	0.40	0.78	0.78	0.78	0.92	0.92	0.92	0.88	0.88	0.88
Adj flow	67	82	60	87	22	53	13	316	70	33	386	32
No. Lanes	0	1	0	0	1	0	0	1	0	0	1	0
Lane group	LTR			LTR			LTR			LTR		
Adj flow	209			162			399			451		
Prop LTs	0.321			0.537			0.033			0.073		
Prop RTs	0.287			0.327			0.175			0.071		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)_____

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			LTR			LTR		
So	1900			1900			1900			1900		
Lanes 0	1	0	0	1	0	0	1	0	0	1	0	0
fW	1.133			1.133			1.133			1.133		
fHV	1.000			1.000			0.971			0.952		
fG	1.000			1.000			1.000			1.000		
fP	1.000			1.000			1.000			1.000		
fBB	1.000			1.000			0.992			0.992		
fA	1.000			1.000			1.000			1.000		
fLU	1.000			1.000			1.000			1.000		
fRT	0.961			0.956			0.976			0.990		
fLT	0.984			0.974			0.981			0.951		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	2037			2004			1987			1917		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	209	2037	# 0.10	0.12	238	0.88
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	162	2004	# 0.08	0.25	501	0.32
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	399	1987	0.20	0.38	762	0.52
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	451	1917	# 0.24	0.38	735	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.88	0.12	26.1	1.000	238	0.50	33.7	0.0	59.8	E	59.8	E	
Westbound													
LTR	0.32	0.25	18.4	1.000	501	0.50	1.7	0.0	20.1	C	20.1	C	
Northbound													
LTR	0.52	0.38	14.3	1.000	762	0.50	2.6	0.0	16.8	B	16.8	B	
Southbound													
LTR	0.61	0.38	14.9	1.000	735	0.50	3.8	0.0	18.7	B	18.7	B	

Intersection delay = 25.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			23.0	23.0
Effective permitted green time for LT lane group, g(s)			23.0	23.0
Opposing effective green time, go (s)			23.0	23.0
Number of lanes in LT lane group, N			1	1

Number of lanes in opposing approach, No			1	1
Adjusted LT flow rate, VLT (veh/h)			13	33
Proportion of LT in LT lane group, PLT	0.321	0.537	0.033	0.073
Proportion of LT in opposing flow, PLTo			0.07	0.03
Adjusted opposing flow rate, Vo (veh/h)			451	399
Lost time for LT lane group, tL			5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600			0.22	0.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.52	6.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			11.6	7.7
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.62	0.62
gq, (see Exhibit C16-4,5,6,7,8)			8.76	7.54
gu=g-gq if gq>=gf, or = g-gf if gq<gf			11.44	15.26
n=Max(gq-gf)/2,0)			0.00	0.00
PTHo=1-PLTo			0.93	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.03	0.07
EL1 (refer to Exhibit C16-3)			2.19	2.08
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.09	0.09
gdifff=max(gq-gf,0)			0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.98	0.95
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.981	0.951

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				23.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				7.54
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.328
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				399
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.073
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	7.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	7.0		23.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.287	0.175
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	26.5	26.1	0.00	0.0	0.0	59.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	18.4	0.00	0.0	0.0	20.1
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.3	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	18.5	14.9	0.00	0.0	0.0	18.7
	0.0						0.0	
Intersection Delay			25.3	sec/veh	Intersection LOS		C	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		LTR		LTR	
Init Queue	0.0		0.0		0.0		0.0	
Flow Rate	209		162		399		451	
So	1900		1900		1900		1900	
No.Lanes	1	0	1	0	1	0	1	0
SL	2037		2004		1987		1917	
LnCapacity	238		501		762		735	
Flow Ratio	0.1		0.1		0.2		0.2	
v/c Ratio	0.88		0.32		0.52		0.61	
Grn Ratio	0.12		0.25		0.38		0.38	
I Factor	1.000		1.000		1.000		1.000	
AT or PVG	3		3		3		3	
Pltn Ratio	1.00		1.00		1.00		1.00	
PF2	1.00		1.00		1.00		1.00	
Q1	3.4		2.2		5.1		6.1	
kB	0.3		0.5		0.7		0.7	
Q2	1.6		0.3		0.8		1.1	
Q Average	5.0		2.5		5.9		7.1	
Q Spacing	25.0		25.0		25.0		25.0	
Q Storage	0		0		0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.3		1.2		1.2	
BOQ	6.2		3.1		7.3		8.7	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.6		1.5		1.5	
BOQ	7.6		3.9		8.8		10.5	
QSRatio								
90th Percentile Output:								
fB%	1.7		1.8		1.7		1.6	
BOQ	8.4		4.4		9.8		11.6	
QSRatio								
95th Percentile Output:								
fB%	2.0		2.2		1.9		1.8	
BOQ	9.9		5.4		11.3		13.1	
QSRatio								
98th Percentile Output:								
fB%	2.3		2.6		2.2		2.1	
BOQ	11.3		6.4		12.7		14.7	
QSRatio								

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R		4 L	5 T	6 R
Volume			330	33		33	398	
Peak-Hour Factor, PHF			0.92	0.92		0.88	0.88	
Hourly Flow Rate, HFR			358	35		37	452	
Percent Heavy Vehicles			--	--		5	--	--
Median Type/Storage		Undivided				/		
RT Channelized?								
Lanes			1	0		0	1	
Configuration				TR			LT	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R		10 L	11 T	12 R
Volume		30		36				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		40		48				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0				0	
Flared Approach: Exists?/Storage				No	/			/
Lanes		0		0				
Configuration			LR					

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound			Eastbound		
	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		37		88				
C(m) (vph)		1149		426				
v/c		0.03		0.21				
95% queue length		0.10		0.77				
Control Delay		8.2		15.6				
LOS		A		C				
Approach Delay				15.6				
Approach LOS				C				

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		330	33	33	398	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		90	9	9	113	
Hourly Flow Rate, HFR		358	35	37	452	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1	0	0	1	
Configuration			TR		LT	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R

Volume	30		36			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	10		12			
Hourly Flow Rate, HFR	40		48			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage			No	/		/
RT Channelized?						
Lanes	0		0			
Configuration		LR				

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		452
Shared ln volume, major rt vehicles:		0
Sat flow rate, major th vehicles:		1700
Sat flow rate, major rt vehicles:		1700
Number of major street through lanes:		1

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		393	902		376			
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	376	
Potential Capacity	668	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	668	
Probability of Queue free St.	0.93	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows	393	
Potential Capacity	1149	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1149	
Probability of Queue free St.	0.97	1.00
Maj L-Shared Prob Q free St.	0.96	
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.96	0.96
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	902	
Potential Capacity	307	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.96
Maj. L, Min T Adj. Imp Factor.		0.97
Cap. Adj. factor due to Impeding mvmnt	0.97	0.90
Movement Capacity	297	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.96 0.96
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 902
Potential Capacity 307
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.96
Maj. L, Min T Adj. Imp Factor. 0.97
Cap. Adj. factor due to Impeding mvmnt 0.97 0.90
Movement Capacity 297

Results for Two-stage process:
a
y
C t 297

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	40		48			
Movement Capacity (vph)	297		668			
Shared Lane Capacity (vph)		426				

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	297		668			
Volume	40		48			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh		426				
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		LT		LR				
v (vph)		37		88				
C(m) (vph)		1149		426				
v/c		0.03		0.21				
95% queue length		0.10		0.77				
Control Delay		8.2		15.6				
LOS		A		C				
Approach Delay				15.6				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.97
v(i1), Volume for stream 2 or 5		452
v(i2), Volume for stream 3 or 6		0
s(i1), Saturation flow rate for stream 2 or 5		1700
s(i2), Saturation flow rate for stream 3 or 6		1700
P*(oj)		0.96
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		1
d(rank,1) Delay for stream 2 or 5		0.4

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	10	5	430	27	547	5	192	447	317	242	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1743	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	545	1309	0.91	0.42	35.7	D	62.6	E
R	539	1293	1.10	0.42	85.1	F		

Northbound

LTR	742	1782	0.95	0.42	38.1	D	38.1	D
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	311	746	1.97	0.42	467.4	F	467.4	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 157.5 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	430	27	547	5	192	447	317	242	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	117	7	149	2	53	123	87	66	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			496	595		707			614	
%InSharedLn												
Prop LTs		0.000			0.942			0.007			0.567	
Prop RTs		0.313			0.000	1.000		0.694			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	430	27	547	5	192	447	317	242	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	467	29	595	5	211	491	348	266	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			496 595			707			614		
Prop LTs	0.000			0.942			0.007			0.567		
Prop RTs	0.313			0.000 1.000			0.694			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.958			1.000 0.850			0.906			1.000		
fLT	1.000			0.727			0.996			0.360		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1309 1293			1782			746		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	496	1309	0.38	0.42	545	0.91
Right	R	595	1293	# 0.46	0.42	539	1.10
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	707	1782	0.40	0.42	742	0.95
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	614	746	# 0.82	0.42	311	1.97
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.28
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.54

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B	
Westbound													
LT	0.91	0.42	16.4	1.000	545	0.50	19.2	0.0	35.7	D	62.6	E	
R	1.10	0.42	17.5	1.000	539	0.50	67.6	0.0	85.1	F			
Northbound													
LTR	0.95	0.42	16.9	1.000	742	0.50	21.1	0.0	38.1	D	38.1	D	
Southbound													
LTR	1.97	0.42	17.5	1.000	311	0.50	449.9	0.0	467.4	F	467.4	F	

Intersection delay = 157.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	467	5	348
Proportion of LT in LT lane group, PLT	0.000	0.942	0.007	0.567
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.57	0.01
Adjusted opposing flow rate, Vo (veh/h)	496	16	614	707
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.78	0.08	5.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.27	0.27	10.23	11.78
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.95	0.00	11.42	13.28
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.05	25.00	9.12	11.72
n=Max(gq-gf)/2,0)	4.48	0.00	0.00	6.64
PTHo=1-PLTo	0.06	1.00	0.43	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.57
EL1 (refer to Exhibit C16-3)	2.29	1.40	2.57	2.82
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.06		1.00	6.51
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.16	0.08	0.13
gdifff=max(gq-gf,0)	8.95	0.00	0.00	13.28
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.64	0.73	1.00	0.36
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.727	0.996	0.360

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.95		11.42	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.358		0.457	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	496		614	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.4	0.00	0.0	0.0	35.7
R	0.0	0.00	17.5	17.5	0.00	14.0	0.0	85.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	16.9	0.00	0.0	0.0	38.1
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	75.8	0.0	467.4
	0.0						0.0	
Intersection Delay			157.5	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound			
LaneGroup	LTR			LT	R	LTR			LTR			
Init Queue	0.0			0.0	0.0	0.0			0.0			
Flow Rate	16			496	595	707			614			
So	1900			1900	1900	1900			1900			
No.Lanes	0	1	0	0	1	1	0	1	0	0	1	0
SL	1743			1309	1293	1782			746			
LnCapacity	726			545	539	742			311			
Flow Ratio	0.0			0.4	0.5	0.4			0.8			
v/c Ratio	0.02			0.91	1.10	0.95			1.97			
Grn Ratio	0.42			0.42	0.42	0.42			0.42			
I Factor	1.000			0.849		0.861			1.000			
AT or PVG	3			3	3	3			3			
Pltn Ratio	1.00			1.00	1.00	1.00			1.00			
PF2	1.00			1.00	1.00	1.00			1.00			
Q1	0.2			7.8	9.9	11.4			10.2			
kB	0.7			0.5	0.5	0.6			0.4			
Q2	0.0			3.2	10.4	5.4			38.6			
Q Average	0.2			10.9	20.3	16.8			48.9			
Q Spacing	25.0			25.0	25.0	25.0			25.0			
Q Storage	0			0	0	0			0			
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.2	1.2			1.2			
BOQ	0.2			13.3	24.4	20.2			58.6			
QSRatio												
85th Percentile Output:												
fB%	1.7			1.4	1.4	1.4			1.4			
BOQ	0.3			15.7	28.5	23.7			68.4			
QSRatio												
90th Percentile Output:												
fB%	2.0			1.6	1.5	1.5			1.5			
BOQ	0.3			17.0	30.6	25.5			73.3			
QSRatio												
95th Percentile Output:												
fB%	2.6			1.7	1.6	1.6			1.6			
BOQ	0.4			18.7	32.8	27.5			78.2			
QSRatio												
98th Percentile Output:												
fB%	3.1			1.9	1.7	1.8			1.7			
BOQ	0.5			20.5	35.0	29.5			83.1			
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: No Bridge St & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Volume				450		9		636			677	
Lane Width					16.0			16.0			16.0	
RTOR Vol						0						

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left		P			SB Left			
Thru					Thru	P		
Right		P			Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 676 2027 0.79 0.33 22.7 C 22.7 C

Northbound

T 1026 2051 0.68 0.50 14.5 B 14.5 B

Southbound

T 1027 2054 0.72 0.50 13.4 B 13.4 B

Intersection Delay = 16.3 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: No Bridge St & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: North Bridge Street N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				450		9	636			677		
% Heavy Veh				1		1	5			4		
PHF				0.86		0.86	0.91			0.91		
PK 15 Vol				131		3	175			186		
Hi Ln Vol												
% Grade					0		0			0		
Ideal Sat					1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			T			T	
Lane Width					16.0		16.0			16.0		
RTOR Vol						0						
Adj Flow					533		699			744		
%InSharedLn												
Prop LTs					0.981		0.000			0.000		
Prop RTs					0.019		0.000			0.000		
Peds Bikes	0			0								
Buses					0		0			2		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.483			0.865			0.367		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	13.5			13.8								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				450		9	636			677		
PHF				0.86		0.86	0.91			0.91		
Adj flow				523		10	699			744		
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			T			T	
Adj flow					533			699			744	
Prop LTs					0.981			0.000			0.000	
Prop RTs					0.019			0.000			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			T			T	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.133			1.133			1.133	
fHV					0.990			0.952			0.962	
fG					1.000			1.000			1.000	
fP					1.000			1.000			1.000	
fBB					1.000			1.000			0.992	
fA					1.000			1.000			1.000	
FLU					1.000			1.000			1.000	
fRT					0.997			1.000			1.000	
FLT					0.953			1.000			1.000	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					2027			2051			2054	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	533	2027	# 0.26	0.33	676	0.79
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	699	2051	0.34	0.50	1026	0.68
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	744	2054	# 0.36	0.50	1027	0.72
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.75

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios v/c	Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group Delay LOS		Approach Delay LOS	
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Eastbound

Westbound

LR	0.79	0.33	18.1	1.000	676	0.50	4.6	0.0	22.7	C	22.7	C
----	------	------	------	-------	-----	------	-----	-----	------	---	------	---

Northbound

T	0.68	0.50	11.4	1.000	1026	0.50	3.2	0.0	14.5	B	14.5	B
---	------	------	------	-------	------	------	-----	-----	------	---	------	---

Southbound

T	0.72	0.50	11.8	1.000	1027	0.50	1.7	0.0	13.4	B	13.4	B
---	------	------	------	-------	------	------	-----	-----	------	---	------	---

Intersection delay = 16.3 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.981 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 60.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	20.0	18.1	0.00	0.0	0.0	22.7
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.4	0.00	0.0	0.0	14.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	15.0	11.8	0.00	0.0	0.0	13.4
	0.0						0.0	
Intersection Delay			16.3	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: So Bridge St & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		636	269	191	935	
Peak-Hour Factor, PHF		0.91	0.91	0.91	0.91	
Peak-15 Minute Volume		175	74	52	257	
Hourly Flow Rate, HFR		698	295	209	1027	
Percent Heavy Vehicles		--	--	6	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						
Peak Hour Factor, PHF						
Peak-15 Minute Volume						
Hourly Flow Rate, HFR						
Percent Heavy Vehicles						
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes						
Configuration						

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1						
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		6						
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00						
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2						
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20						
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		6						
t(f)		2.3						

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x		993						
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)
 S
 P(x)
 V(c,u,x)

C(r,x)
 C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	993	
Potential Capacity	681	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	681	
Probability of Queue free St.	0.69	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		
Maj. L, Min T Adj. Imp Factor.		
Cap. Adj. factor due to Impeding mvmnt	0.69	0.69
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.69 0.69
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor
Maj. L, Min T Adj. Imp Factor.
Cap. Adj. factor due to Impeding mvmnt 0.69 0.69
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)						
Movement Capacity (vph)						
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						
Volume						
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L						
v (vph)		209						
C(m) (vph)		681						
v/c		0.31						
95% queue length		1.30						
Control Delay		12.6						
LOS		B						
Approach Delay								
Approach LOS								

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.69
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		12.6
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Volume				107		235	652	93		168	743	
Lane Width					12.0		15.0				15.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 392 1470 0.98 0.27 61.1 E 61.1 E

Northbound

TR 1132 1998 0.72 0.57 12.7 B 12.7 B

Southbound

LT 617 1089 1.62 0.57 295.1 F 295.1 F

Intersection Delay = 149.5 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				107		235	652	93		168	743	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				30		66	179	26		46	204	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900			1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig					LR			TR			LT	
Lane Width					12.0			15.0			15.0	
RTOR Vol						0			0			
Adj Flow					384			818			1001	
%InSharedLn												
Prop LTs					0.313			0.000			0.185	
Prop RTs					0.688			0.125			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0		
Arriv. Type				3			3			3		
Unit Ext.				3.0			3.0			3.0		
I Factor				0.940			0.789			0.272		
Lost Time				2.0			2.0			2.0		
Ext of g				2.0			2.0			2.0		
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				107		235	652	93		168	743	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				120		264	716	102		185	816	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group					LR			TR			LT	
Adj flow					384			818			1001	
Prop LTs					0.313			0.000			0.185	
Prop RTs					0.688			0.125			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG					LR			TR			LT	
So					1900			1900			1900	
Lanes	0	0	0	0	0	0	0	1	0	0	1	0
fW					1.000			1.100			1.100	
fHV					0.990			0.980			0.980	
fG					1.000			1.000			1.000	
fP					0.875			1.000			1.000	
fBB					1.000			0.992			0.992	
fA					1.000			1.000			1.000	
fLU					1.000			1.000			1.000	
fRT					0.907			0.983			1.000	
fLT					0.985			1.000			0.536	
Sec.												
fLpb					1.000			1.000			1.000	
fRpb					1.000			1.000			1.000	
S					1470			1998			1089	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	384	1470	# 0.26	0.27	392	0.98
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	818	1998	0.41	0.57	1132	0.72
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	1001	1089	# 0.92	0.57	617	1.62
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.18
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.42

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.98	0.27	21.8	1.000	392	0.50	39.3	0.0	61.1	E	61.1	E
Northbound												
TR	0.72	0.57	9.5	1.000	1132	0.50	3.2	0.0	12.7	B	12.7	B
Southbound												
LT	1.62	0.57	13.0	1.000	617	0.50	282.1	0.0	295.1	F	295.1	F

Intersection delay = 149.5 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0				
sec				
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No			1
Adjusted LT flow rate, VLT (veh/h)			185
Proportion of LT in LT lane group, PLT	0.313	0.000	0.185
Proportion of LT in opposing flow, PLTo			0.00
Adjusted opposing flow rate, Vo (veh/h)			818
Lost time for LT lane group, tL			5.00
Computation			
LT volume per cycle, LTC=VLTC/3600			3.08
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			13.63
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.9
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]			0.43
gq, (see Exhibit C16-4,5,6,7,8)			9.90
gu=g-gq if gq>=gf, or = g-gf if gq<gf			24.10
n=Max(gq-gf)/2,0)			4.49
PTHo=1-PLTo			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			0.18
EL1 (refer to Exhibit C16-3)			3.13
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g			0.07
gdifff=max(gq-gf,0)			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.54
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT			0.536

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				9.90
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.291
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				818
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.185
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	16.0	34.0
Conflicting pedestrian volume, Vped (p/h)	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0
Vpedg	0	0
OCCpedg	0.000	0.000
Effective green, g (s)	16.0	34.0
Vbicg	0	0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.688	0.125
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.8	0.00	0.0	0.0	61.1
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.5	0.00	0.0	0.0	12.7
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	13.0	13.0	0.00	96.0	0.0	295.1
	0.0						0.0	
Intersection Delay			149.5	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup												
Init Queue												
Flow Rate												
So												
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL												
LnCapacity												
Flow Ratio												
v/c Ratio												
Grn Ratio												
I Factor												
AT or PVG												
Pltn Ratio												
PF2												
Q1												
kB												
Q2												
Q Average												
Q Spacing												
Q Storage												
Q S Ratio												
70th Percentile Output:												
fB%												
BOQ												
QSRatio												
85th Percentile Output:												
fB%												
BOQ												
QSRatio												
90th Percentile Output:												
fB%												
BOQ												
QSRatio												
95th Percentile Output:												
fB%												
BOQ												
QSRatio												
98th Percentile Output:												
fB%												
BOQ												
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Richmond Valley Rd & Page Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Page Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig	LTR			LTR			L	TR		LTR		
Volume	103	52	124	31	95	88	174	779	144	69	619	101
Lane Width	16.0			15.0			10.0	14.0		10.5		
RTOR Vol	0			0			0			20		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0					49.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	476	1382	0.75	0.34	31.9	C	31.9	C
-----	-----	------	------	------	------	---	------	---

Westbound

LTR	537	1559	0.55	0.34	27.8	C	27.8	C
-----	-----	------	------	------	------	---	------	---

Northbound

L	268	493	0.71	0.54	23.6	C		
TR	1067	1960	0.94	0.54	29.9	C	28.9	C

Southbound

LTR	922	1694	0.91	0.54	32.1	C	32.1	C
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 30.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Richmond Valley Rd & Page Ave
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
E/W St: Richmond Valley Road N/S St: Page Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	103	52	124	31	95	88	174	779	144	69	619	101
% Heavy Veh	0	0	0	1	1	1	1	1	1	1	1	1
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
PK 15 Vol	33	17	40	11	33	30	47	212	39	19	168	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		1900	1900			1900	
ParkExist						X						X
NumPark						5						5
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
LGConfig		LTR			LTR		L	TR			LTR	
Lane Width		16.0			15.0		10.0	14.0			10.5	
RTOR Vol			0			0			0			20
Adj Flow		358			293		189	1004			836	
%InSharedLn												
Prop LTs		0.369			0.143		1.000	0.000			0.090	
Prop RTs		0.444			0.413			0.156			0.105	
Peds Bikes	0	0		0	0		0	0		0	0	
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.533			1.000			0.561			0.957	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		16.6			21.5			16.3			21.2	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		31.0						49.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	103	52	124	31	95	88	174	779	144	69	619	101
PHF	0.78	0.78	0.78	0.73	0.73	0.73	0.92	0.92	0.92	0.92	0.92	0.92
Adj flow	132	67	159	42	130	121	189	847	157	75	673	88
No. Lanes	0	1	0	0	1	0	1	1	0	0	2	0
Lane group	LTR			LTR			L TR			LTR		
Adj flow	358			293			189 1004			836		
Prop LTs	0.369			0.143			1.000 0.000			0.090		
Prop RTs	0.444			0.413			0.156			0.105		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			L TR			LTR		
So	1900			1900			1900 1900			1900		
Lanes 0	1	0	0	1	0		1	1	0	0	2	0
fW	1.133			1.100			0.933 1.067			0.950		
fHV	1.000			0.990			0.990 0.990			0.990		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			0.875			1.000 1.000			0.938		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	1.000			1.000			1.000 1.000			0.952		
fRT	0.940			0.944			0.977			0.984		
fLT	0.683			0.912			0.281 1.000			0.540		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	1382			1559			493 1960			1694		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	358	1382	# 0.26	0.34	476	0.75
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	293	1559	0.19	0.34	537	0.55
Right							
Northbound							
Prot							
Perm							
Left	L	189	493	0.38	0.54	268	0.71
Prot							
Perm							
Thru	TR	1004	1960	# 0.51	0.54	1067	0.94
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	836	1694	0.49	0.54	922	0.91
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.77
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.87

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.75	0.34	26.1	1.000	476	0.50	5.8	0.0	31.9	C	31.9	C	
Westbound													
LTR	0.55	0.34	23.8	1.000	537	0.50	3.9	0.0	27.8	C	27.8	C	
Northbound													
L	0.71	0.54	15.2	1.000	268	0.50	8.5	0.0	23.6	C			
TR	0.94	0.54	19.1	1.000	1067	0.50	10.7	0.0	29.9	C	28.9	C	
Southbound													
LTR	0.91	0.54	18.4	1.000	922	0.50	13.7	0.0	32.1	C	32.1	C	

Intersection delay = 30.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			49.0	
Effective permitted green time for LT lane group, g(s)			49.0	
Opposing effective green time, go (s)			49.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			189	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.09	
Adjusted opposing flow rate, Vo (veh/h)			836	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			4.72	
Opposing lane util. factor, fLUo	1.000	1.000	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			10.98	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.46	
gq, (see Exhibit C16-4,5,6,7,8)			8.23	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			40.77	
n=Max(gq-gf)/2,0)			4.11	
PTHo=1-PLTo			0.91	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.96	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.57	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.08	
gdifff=max(gq-gf,0)			8.23	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.28	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.281	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)	31.0	31.0		49.0
Effective permitted green time for LT lane group, g(s)	31.0	31.0		49.0
Opposing effective green time, go (s)	31.0	31.0		49.0
Number of lanes in LT lane group, N	1	1		2

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	132	42	75
Proportion of LT in LT lane group, PLT	0.369	0.143	0.000
Proportion of LT in opposing flow, PLTo	0.14	0.37	0.00
Adjusted opposing flow rate, Vo (veh/h)	293	358	1004
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	3.30	1.05	1.88
Opposing lane util. factor, fLUo	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.32	8.95	25.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	7.8	7.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.66	0.66	0.46
gq, (see Exhibit C16-4,5,6,7,8)	9.40	11.78	46.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.60	19.22	2.29
n=Max(gq-gf)/2,0)	4.70	2.00	19.72
PTHo=1-PLTo	0.86	0.63	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.14	0.45
EL1 (refer to Exhibit C16-3)	1.87	2.00	3.75
EL2=Max((1-Ptho**n)/Plto, 1.0)	3.60	1.63	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.07	0.06
gdifff=max(gq-gf,0)	9.39	4.01	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.68	0.91	0.17
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.683	0.912	0.540

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	9.40	11.78	8.23	46.71
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.303	0.380	0.168	0.953
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	293	358	836	1004
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	0.369	0.143	1.000	0.090
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	31.0	31.0	49.0	49.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	31.0	31.0	49.0	49.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.444	0.413	0.156	0.105
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	26.1	0.00	0.0	0.0	31.9
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	23.8	0.00	0.0	0.0	27.8
	0.0						0.0	
Northbound								
L	0.0	0.00	20.5	15.2	0.00	0.0	0.0	23.6
TR	0.0	0.00	20.5	19.1	0.00	0.0	0.0	29.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	20.5	18.4	0.00	0.0	0.0	32.1
	0.0						0.0	
Intersection Delay			30.2	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		L	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	358		293		189	1004	439	
So	1900		1900		1900	1900	1900	
No.Lanes	0 1 0	0 0	1 0	0	1 1 0	0 0	2 0	
SL	1382		1559		493	1960	889	
LnCapacity	476		537		268	1067	484	
Flow Ratio	0.3		0.2		0.4	0.5	0.5	
v/c Ratio	0.75		0.55		0.71	0.94	0.91	
Grn Ratio	0.34		0.34		0.54	0.54	0.54	
I Factor	0.533		1.000			0.561	0.957	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	7.9		5.9		3.5	23.4	9.9	
kB	0.4		0.7		0.3	0.7	0.7	
Q2	1.0		0.9		0.6	6.0	3.8	
Q Average	8.9		6.8		4.1	29.5	13.7	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	10.9		8.3		5.1	35.4	16.5	
QSRatio								
85th Percentile Output:								
fB%	1.5		1.5		1.5	1.4	1.4	
BOQ	13.0		10.0		6.2	41.3	19.4	
QSRatio								
90th Percentile Output:								
fB%	1.6		1.6		1.7	1.5	1.5	
BOQ	14.2		11.0		7.0	44.3	21.0	
QSRatio								
95th Percentile Output:								
fB%	1.8		1.9		2.0	1.6	1.7	
BOQ	15.8		12.6		8.3	47.3	22.8	
QSRatio								
98th Percentile Output:								
fB%	2.0		2.1		2.4	1.7	1.8	
BOQ	17.4		14.1		9.6	50.3	24.6	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Br St & Page Ave/Boscome Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L							T			T	
Volume	403						969			732		
Lane Width	16.0						14.5			12.0		
RTOR Vol												

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				50.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	669	2006	0.70	0.33	32.1	C	32.1	C

Westbound

Northbound

T 2134 3842 0.47 0.56 12.5 B 12.5 B

Southbound

T 1951 3512 0.41 0.56 12.1 B 12.1 B

Intersection Delay = 16.4 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Br St & Page Ave/Boscome Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: South Bridge Street N/S St: Page Avenue/Boscome Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	403						969			732		
% Heavy Veh	2						2			3		
PHF	0.86						0.96			0.92		
PK 15 Vol	117						252			199		
Hi Ln Vol												
% Grade		0					0			0		
Ideal Sat	1900						1900			1900		
ParkExist												
NumPark												
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
LGConfig	L						T			T		
Lane Width	16.0						14.5			12.0		
RTOR Vol												
Adj Flow	469						1009			796		
%InSharedLn												
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		
Peds Bikes				0								
Buses	0						0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0						0.0			0.0		
Arriv. Type	3						3			3		
Unit Ext.	3.0						3.0			3.0		
I Factor		1.000					0.567			0.957		
Lost Time	2.0						2.0			2.0		
Ext of g	2.0						2.0			2.0		
Ped Min g				20.1								

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0							50.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	403						969			732		
PHF	0.86						0.96			0.92		
Adj flow	469						1009			796		
No. Lanes	1	0	0	0	0	0	0	2	0	0	2	0
Lane group	L						T			T		
Adj flow	469						1009			796		
Prop LTs							0.000			0.000		
Prop RTs							0.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	L						T			T		
So	1900						1900			1900		
Lanes	1	0	0	0	0	0	2	0	0	2	0	0
fW	1.133						1.083			1.000		
fHV	0.980						0.980			0.971		
fG	1.000						1.000			1.000		
fP	1.000						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						0.952			0.952		
fRT							1.000			1.000		
fLT	0.950						1.000			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb							1.000			1.000		
S	2006						3842			3512		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	469	2006	# 0.23	0.33	669	0.70
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	1009	3842	# 0.26	0.56	2134	0.47
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	T	796	3512	0.23	0.56	1951	0.41
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.50
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.70	0.33	26.1	1.000	669	0.50	6.0	0.0	32.1	C	32.1	C	
Westbound													
Northbound													
T	0.47	0.56	12.1	1.000	2134	0.50	0.4	0.0	12.5	B	12.5	B	
Southbound													
T	0.41	0.56	11.5	1.000	1951	0.50	0.6	0.0	12.1	B	12.1	B	

Intersection delay = 16.4 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No

Adjusted LT flow rate, VLT (veh/h)

Proportion of LT in LT lane group, PLT

Proportion of LT in opposing flow, PLTo

Adjusted opposing flow rate, Vo (veh/h)

Lost time for LT lane group, tL

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo

0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach

or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

EB WB NB SB

Opposed by Single(S) or Multiple(M) lane approach

Cycle length, C 90.0 sec

Total actual green time for LT lane group, G (s)

Effective permitted green time for LT lane group, g(s)

Opposing effective green time, go (s)

Number of lanes in LT lane group, N

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	26.1	0.00	0.0	0.0	32.1
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
T	0.0	0.00	20.0	12.1	0.00	0.0	0.0	12.5
	0.0						0.0	
Southbound								
	0.0						0.0	
T	0.0	0.00	20.0	11.5	0.00	0.0	0.0	12.1
	0.0						0.0	
Intersection Delay			16.4	sec/veh	Intersection LOS B			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L						T			T		
Init Queue	0.0						0.0			0.0		
Flow Rate	469						529			418		
So	1900						1900			1900		
No.Lanes	1	0	0	0	0	0	0	2	0	0	2	0
SL	2006						2017			1844		
LnCapacity	669						1120			1024		
Flow Ratio	0.2						0.3			0.2		
v/c Ratio	0.70						0.47			0.41		
Grn Ratio	0.33						0.56			0.56		
I Factor	1.000						0.567			0.957		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	10.2						8.0			6.0		
kB	0.9						0.7			1.1		
Q2	1.9						0.6			0.8		
Q Average	12.1						8.6			6.8		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	14.6						10.5			8.3		
QSRatio												
85th Percentile Output:												
fB%	1.4						1.5			1.5		
BOQ	17.2						12.5			10.0		
QSRatio												
90th Percentile Output:												
fB%	1.5						1.6			1.6		
BOQ	18.7						13.7			11.0		
QSRatio												
95th Percentile Output:												
fB%	1.7						1.8			1.9		
BOQ	20.4						15.3			12.6		
QSRatio												
98th Percentile Output:												
fB%	1.8						2.0			2.1		
BOQ	22.2						16.9			14.1		
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound	
		1	2	3	4	5	6
		L	T	R	L	T	R
Volume						732	
Peak-Hour Factor, PHF						0.92	
Hourly Flow Rate, HFR						795	
Percent Heavy Vehicles		--	--			--	--
Median Type/Storage		Raised curb / 1					
RT Channelized?							
Lanes						2	
Configuration						T	
Upstream Signal?		No				No	

Minor Street:	Approach Movement	Westbound				Eastbound	
		7	8	9	10	11	12
		L	T	R	L	T	R
Volume							57
Peak Hour Factor, PHF							0.88
Hourly Flow Rate, HFR							64
Percent Heavy Vehicles							5
Percent Grade (%)		0				0	
Flared Approach: Exists?/Storage					/		/
Lanes						1	
Configuration						R	

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound	
	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								64
C(m) (vph)								645
v/c								0.10
95% queue length								0.33
Control Delay								11.2
LOS								B
Approach Delay							11.2	
Approach LOS							B	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: S Bridge St RT & Page Ave
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: South Bridge Street Right Turn
 North/South Street: Page Avenue
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					732	
Peak-Hour Factor, PHF					0.92	
Peak-15 Minute Volume					199	
Hourly Flow Rate, HFR					795	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage		Raised curb		/ 1		
RT Channelized?						
Lanes					2	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume						57
Peak Hour Factor, PHF						0.88
Peak-15 Minute Volume						16
Hourly Flow Rate, HFR						64
Percent Heavy Vehicles						5
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						No
Lanes						1
Configuration						R

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)								6.2
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)								5
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)								0.00
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage								6.3
2-stage								6.3
Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)								3.30
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)								5
t(f)								3.3

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
V prog			

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x								398
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

Stage1 Stage2 Stage1 Stage2 Stage1 Stage2 Stage1 Stage2

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St. 9 12

Conflicting Flows 398
Potential Capacity 645
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity 645
Probability of Queue free St. 1.00 0.90

Step 2: LT from Major St. 4 1

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00
Maj L-Shared Prob Q free St.

Step 3: TH from Minor St. 8 11

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 0.90 1.00
Movement Capacity

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St. 8 11

Part 1 - First Stage
Conflicting Flows
Potential Capacity 900 402
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 900 402
Probability of Queue free St. 1.00 1.00

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	402	900
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	402	900

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		

Result for 2 stage process:		
a	0.91	0.91
y		
C t		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity	1029	448
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	1029	448

Part 2 - Second Stage		
Conflicting Flows		
Potential Capacity	683	1029
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.90	1.00
Movement Capacity	615	1029

Part 3 - Single Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor	1.00	
Maj. L, Min T Adj. Imp Factor.	1.00	
Cap. Adj. factor due to Impeding mvmnt	0.90	1.00
Movement Capacity		

Results for Two-stage process:		
a	0.91	0.91
y		
C t		

Worksheet 8-Shared Lane Calculations

Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (vph)						64
Movement Capacity (vph)						645
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep						645
Volume						64
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config								R
v (vph)								64
C(m) (vph)								645
v/c								0.10
95% queue length								0.33
Control Delay								11.2
LOS								B
Approach Delay							11.2	
Approach LOS							B	

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						637			
Peak-Hour Factor, PHF						0.93			
Hourly Flow Rate, HFR						684			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		178							
Peak Hour Factor, PHF		0.90							
Hourly Flow Rate, HFR		197							
Percent Heavy Vehicles		1							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			197							
C(m) (vph)			416							
v/c			0.47							
95% queue length			2.47							
Control Delay			21.2							
LOS			C							
Approach Delay				21.2						
Approach LOS				C						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 637
 Peak-Hour Factor, PHF 0.93
 Peak-15 Minute Volume 171
 Hourly Flow Rate, HFR 684
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.90
 Peak-15 Minute Volume 49
 Hourly Flow Rate, HFR 197
 Percent Heavy Vehicles 1
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr)	0	0	0	0
---------------	---	---	---	---

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			684					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	684	
Potential Capacity	416	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	416	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 684
Potential Capacity 416
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 416

Results for Two-stage process:
a
y
C t 416

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	197					
Movement Capacity (vph)	416					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	416					
Volume	197					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			197					
C(m) (vph)			416					
v/c			0.47					
95% queue length			2.47					
Control Delay			21.2					
LOS			C					
Approach Delay				21.2				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	176	464	227	272	772	102	243	479	221	243	140	159
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	81	242	2.33	0.33	656.1	F		
TR	601	1803	1.15	0.33	110.8	F	227.9	F
Westbound								
L	83	240	3.41	0.34	1141	F		
TR	1191	3457	0.93	0.34	41.3	D	265.1	F
Northbound								
LTR	964	3469	1.09	0.28	88.1	F	88.1	F
Southbound								
L	384	1728	0.75	0.22	43.8	D		
TR	359	1616	0.99	0.22	76.8	E	62.0	E

Intersection Delay = 177.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
Intersection: Veterans Rd W & Bricktown/KWVP
Area Type: All other areas
Jurisdiction: Staten Island
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
E/W St: Veterans Road West

N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	176	464	227	272	772	102	243	479	221	243	140	159
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	125	61	71	247	33	68	133	61	72	42	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	189	691		283	1107			1048		289	356	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.258			0.000	
Prop RTs		0.278			0.106			0.235			0.531	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	176	464	227	272	772	102	243	479	221	243	140	159
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	189	499	192	283	990	117	270	532	246	289	167	189
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	189	691		283	1107			1048		289	356	
Prop LTs	1.000	0.000		1.000	0.000			0.258			0.000	
Prop RTs		0.278			0.106			0.235			0.531	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.958			0.984		0.965				0.920	
fLT	0.133	1.000		0.129	1.000		0.987			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	242	1803		240	3457		3469			1728	1616	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	189	242	0.78	0.33	81	2.33
Prot							
Perm							
Thru	TR	691	1803	0.38	0.33	601	1.15
Right							
Westbound							
Prot							
Perm							
Left	L	283	240	# 1.18	0.34	83	3.41
Prot							
Perm							
Thru	TR	1107	3457	0.32	0.34	1191	0.93
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1048	3469	# 0.30	0.28	964	1.09
Right							
Southbound							
Prot							
Perm							
Left	L	289	1728	0.17	0.22	384	0.75
Prot							
Perm							
Thru	TR	356	1616	# 0.22	0.22	359	0.99
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.70
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.02

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	2.33	0.33	30.0	1.000	81	0.50	626.1	0.0	656.1	F			
TR	1.15	0.33	30.0	1.000	601	0.50	80.8	0.0	110.8	F	227.9	F	
Westbound													
L	3.41	0.34	29.5	1.000	83	0.50	1111	0.0	1141	F			
TR	0.93	0.34	28.4	1.000	1191	0.50	12.8	0.0	41.3	D	265.1	F	
Northbound													
LTR	1.09	0.28	32.5	1.000	964	0.50	55.6	0.0	88.1	F	88.1	F	
Southbound													
L	0.75	0.22	32.7	1.000	384	0.50	11.1	0.0	43.8	D			
TR	0.99	0.22	34.9	1.000	359	0.50	41.9	0.0	76.8	E	62.0	E	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.258 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin; max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin ≤ fm ≤ 1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	23.15			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.772			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	1107			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	27.0	0.0	656.1
TR	0.0	0.00	30.0	30.0	0.00	22.5	0.0	110.8
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	50.0	0.0	1141
TR	0.0	0.00	29.5	28.4	0.00	0.0	0.0	41.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	32.5	0.00	21.0	0.0	88.1
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.7	0.00	0.0	0.0	43.8
TR	0.0	0.00	35.0	34.9	0.00	0.0	0.0	76.8
	0.0						0.0	

Intersection Delay	177.0	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	189	691		283	581		550			289	356	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	242	1803		240	1815		1821			1728	1616	
LnCapacity	81	601		83	625		506			384	359	
Flow Ratio	0.8	0.4		1.2	0.3		0.3			0.2	0.2	
v/c Ratio	2.33	1.15		3.41	0.93		1.09			0.75	0.99	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	4.7	17.3		7.1	14.0		13.8			6.7	8.9	
kB	0.1	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	13.7	14.6		25.3	5.1		10.3			1.4	4.4	
Q Average	18.5	31.8		32.3	19.1		24.0			8.1	13.3	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	22.2	38.2		38.8	23.0		28.8			9.9	16.1	
QSRatio												
85th Percentile Output:												
fB%	1.4	1.4		1.4	1.4		1.4			1.5	1.4	
BOQ	26.0	44.6		45.3	26.9		33.7			11.8	18.9	
QSRatio												
90th Percentile Output:												
fB%	1.5	1.5		1.5	1.5		1.5			1.6	1.5	
BOQ	27.9	47.8		48.5	28.9		36.1			13.0	20.4	
QSRatio												
95th Percentile Output:												
fB%	1.6	1.6		1.6	1.6		1.6			1.8	1.7	
BOQ	30.0	51.0		51.8	31.0		38.6			14.6	22.2	
QSRatio												
98th Percentile Output:												
fB%	1.7	1.7		1.7	1.7		1.7			2.0	1.8	
BOQ	32.1	54.2		55.0	33.1		41.1			16.2	24.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Bricktown Way/Tyrellan Avenue
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Bricktown Way
North/South Street: Tyrellan Avenue

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	21	264	59	110	268	245	61	59	94	111	269	83
% Thrus Left Lane			50			50						50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT	TR	LT	TR	LT	R	LT	TR
PHF	0.85	0.85	0.96	0.99	0.89	0.89	0.92	0.92
Flow Rate	179	224	253	382	134	105	265	236
% Heavy Veh	0	0	0	1	1	1	0	0
No. Lanes		2		2		2		2
Opposing-Lanes		2		2		2		2
Conflicting-lanes		2		2		2		2
Geometry group		5		5		5		5
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	179	224	253	382	134	105	265	236
Left-Turn	24	0	114	0	68	0	120	0
Right-Turn	0	69	0	247	0	105	0	90
Prop. Left-Turns	0.1	0.0	0.5	0.0	0.5	0.0	0.5	0.0
Prop. Right-Turns	0.0	0.3	0.0	0.6	0.0	1.0	0.0	0.4
Prop. Heavy Vehicle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Geometry Group		5		5		5		5
Adjustments Exhibit 17-33:								
hLT-adj		0.5		0.5		0.5		0.5

hRT-adj	-0.7		-0.7		-0.7		-0.7	
hHV-adj	1.7		1.7		1.7		1.7	
hadj, computed	0.1	-0.2	0.2	-0.4	0.3	-0.7	0.2	-0.3

Worksheet 4 - Departure Headway and Service Time

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow rate	179	224	253	382	134	105	265	236
hd, initial value	3.20	3.20	3.20	3.20	3.20	3.20	3.20	3.20
x, initial	0.16	0.20	0.22	0.34	0.12	0.09	0.24	0.21
hd, final value	8.07	7.79	7.88	7.22	8.70	7.75	8.13	7.64
x, final value	0.40	0.48	0.55	0.77	0.32	0.23	0.60	0.50
Move-up time, m	2.3		2.3		2.3		2.3	
Service Time	5.8	5.5	5.6	4.9	6.4	5.4	5.8	5.3

Worksheet 5 - Capacity and Level of Service

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rate	179	224	253	382	134	105	265	236
Service Time	5.8	5.5	5.6	4.9	6.4	5.4	5.8	5.3
Utilization, x	0.40	0.48	0.55	0.77	0.32	0.23	0.60	0.50
Dep. headway, hd	8.07	7.79	7.88	7.22	8.70	7.75	8.13	7.64
Capacity	429	449	450	493	384	355	434	460
Delay	16.07	17.59	19.93	29.82	15.51	12.70	22.25	17.76
LOS	C	C	C	D	C	B	C	C
Approach:								
Delay	16.92		25.88		14.28		20.13	
LOS	C		D		B		C	
Intersection Delay	20.67				Intersection LOS C			

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Tyrellan Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: SFR NB-DefL = 2050
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig	LTR			LTR			DefL	TR		LTR		
Volume	81	198	609	235	645	25	345	268	115	26	831	167
Lane Width	12.0			12.0			13.0	13.0		9.5		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left		P			SB Left	P		
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	23.0			29.0			
Yellow	3.0	3.0			3.0			
All Red	2.0	2.0			2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 809 3167 1.19 0.26 130.5 F 130.5 F

Westbound

LTR 900 3521 1.29 0.26 170.8 F 170.8 F

Northbound

DefL 93 289 3.95 0.32 1382 F
 TR 598 1857 0.70 0.32 33.5 C 661.5 F

Southbound

LTR 974 3024 1.13 0.32 102.7 F 102.7 F

Intersection Delay = 238.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81	198	609	235	645	25	345	268	115	26	831	167
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	22	54	165	75	207	8	92	74	32	7	223	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900		2050	1900			1900	
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
LGConfig		LTR			LTR		DefL	TR			LTR	
Lane Width		12.0			12.0		13.0	13.0			9.5	
RTOR Vol			0			0			0			0
Adj Flow		965			1160		367	421			1102	
%InSharedLn												
Prop LTs		0.091			0.259		1.000	0.000			0.025	
Prop RTs		0.686			0.028			0.299			0.163	
Peds Bikes	0	0		0	0		0	0		0		
Buses		0			0		0	0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0		0.0	0.0			0.0	
Arriv. Type		3			3		3	3			3	
Unit Ext.		3.0			3.0		3.0	3.0			3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time		2.0			2.0		2.0	2.0			2.0	
Ext of g		2.0			2.0		2.0	2.0			2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		23.0	23.0					29.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81	198	609	235	645	25	345	268	115	26	831	167
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	88	215	662	301	827	32	367	295	126	28	894	180
No. Lanes	0	2	0	0	2	0	0	2	0	0	2	0
Lane group	LTR			LTR			DefL TR			LTR		
Adj flow	965			1160			367 421			1102		
Prop LTs	0.091			0.259			1.000 0.000			0.025		
Prop RTs	0.686			0.028			0.299			0.163		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LTR			DefL TR			LTR		
So	1900			1900			2050 1900			1900		
Lanes 0	2	0	0	2	0		0	2	0	0	2	0
fW	1.000			1.000			1.033 1.033			0.917		
fHV	0.980			0.990			0.990 0.990			1.000		
fG	1.000			1.000			1.000 1.000			1.000		
fP	1.000			1.000			1.000 1.000			1.000		
fBB	1.000			1.000			1.000 1.000			1.000		
fA	1.000			1.000			1.000 1.000			1.000		
fLU	0.952			0.952			1.000 1.000			0.952		
fRT	0.897			0.996			0.955			0.975		
fLT	0.995			0.987			0.138 1.000			0.935		
Sec.												
fLpb	1.000			1.000			1.000 1.000			1.000		
fRpb	1.000			1.000			1.000			1.000		
S	3167			3521			289 1857			3024		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	965	3167	# 0.30	0.26	809	1.19
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1160	3521	# 0.33	0.26	900	1.29
Right							
Northbound							
Prot							
Perm							
Left	DefL	367	289	# 1.27	0.32	93	3.95
Prot							
Perm							
Thru	TR	421	1857	0.23	0.32	598	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1102	3024	0.36	0.32	974	1.13
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 1.90
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 2.28

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	1.19	0.26	33.5	1.000	809	0.50	97.0	0.0	130.5	F	130.5	F
Westbound												
LTR	1.29	0.26	33.5	1.000	900	0.50	137.3	0.0	170.8	F	170.8	F
Northbound												
DefL	3.95	0.32	30.5	1.000	93	0.50	1351	0.0	1382	F		
TR	0.70	0.32	26.7	1.000	598	0.50	6.8	0.0	33.5	C	661.5	F
Southbound												
LTR	1.13	0.32	30.5	1.000	974	0.50	72.2	0.0	102.7	F	102.7	F

Intersection delay = 238.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)			29.0	
Effective permitted green time for LT lane group, g(s)			29.0	
Opposing effective green time, go (s)			29.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			2	
Adjusted LT flow rate, VLT (veh/h)			367	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.03	
Adjusted opposing flow rate, Vo (veh/h)			1102	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/C			9.18	
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			14.47	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.68	
gq, (see Exhibit C16-4,5,6,7,8)			23.91	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			5.09	
n=Max(gq-gf)/2,0)			11.96	
PTHo=1-PLTo			0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			3.85	
EL2=Max((1-Ptho*n)/Plto, 1.0)			10.42	
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.14	
gdifff=max(gq-gf,0)			23.91	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.14	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.138	

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				90.0 sec
Total actual green time for LT lane group, G (s)				29.0
Effective permitted green time for LT lane group, g(s)				29.0
Opposing effective green time, go (s)				29.0
Number of lanes in LT lane group, N				2

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	28
Proportion of LT in LT lane group, PLT	0.091 0.259 0.000 0.025
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	421
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.70
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.26
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	9.6
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.68
gq, (see Exhibit C16-4,5,6,7,8)	3.08
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.35
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06
EL1 (refer to Exhibit C16-3)	2.13
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.935

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				29.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				3.08
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.106
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				421
OCCr				0.000
Number of cross-street receiving lanes, Nrec				2
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				0.025
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	23.0	23.0	29.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	23.0	23.0	29.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.686	0.028	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	39.0	0.0	130.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	33.5	33.5	0.00	65.0	0.0	170.8
	0.0						0.0	
Northbound								
DefL	0.0	0.00	30.5	30.5	0.00	68.5	0.0	1382
TR	0.0	0.00	30.5	26.7	0.00	0.0	0.0	33.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	30.5	30.5	0.00	32.0	0.0	102.7
	0.0						0.0	
Intersection Delay			238.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LTR		DefL	TR	LTR	
Init Queue	0.0		0.0		0.0	0.0	0.0	
Flow Rate	506		609		367	421	578	
So	1900		1900		2050	1900	1900	
No.Lanes	0 2 0	0	0 2 0	0	0 2 0	0	0 2 0	0
SL	1663		1849		289	1857	1588	
LnCapacity	424		472		93	598	511	
Flow Ratio	0.3		0.3		1.3	0.2	0.4	
v/c Ratio	1.19		1.29		3.95	0.70	1.13	
Grn Ratio	0.26		0.26		0.32	0.32	0.32	
I Factor	0.830		0.865			1.000	1.000	
AT or PVG	3		3		3	3	3	
Pltn Ratio	1.00		1.00		1.00	1.00	1.00	
PF2	1.00		1.00		1.00	1.00	1.00	
Q1	12.6		15.2		9.2	9.2	14.4	
kB	0.5		0.6		0.2	0.8	0.7	
Q2	12.8		19.4		34.5	1.8	12.5	
Q Average	25.5		34.6		43.7	11.0	27.0	
Q Spacing	25.0		25.0		25.0	25.0	25.0	
Q Storage	0		0		0	0	0	
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2		1.2	1.2	1.2	
BOQ	30.6		41.6		52.5	13.3	32.4	
QSRatio								
85th Percentile Output:								
fB%	1.4		1.4		1.4	1.4	1.4	
BOQ	35.7		48.5		61.2	15.7	37.8	
QSRatio								
90th Percentile Output:								
fB%	1.5		1.5		1.5	1.6	1.5	
BOQ	38.3		52.0		65.6	17.1	40.5	
QSRatio								
95th Percentile Output:								
fB%	1.6		1.6		1.6	1.7	1.6	
BOQ	40.9		55.5		69.9	18.8	43.2	
QSRatio								
98th Percentile Output:								
fB%	1.7		1.7		1.7	1.9	1.7	
BOQ	43.5		58.9		74.3	20.5	46.0	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+™ DETAILED REPORT

General Information		Site Information	
Analyst	KM	Intersection	Boscombe Ave & OBX Off-Ramp
Agency or Co.	AECOM	Area Type	All other areas
Date Performed	2/9/13	Jurisdiction	Sat Flw Rate EB-L = 2100
Time Period	Saturday 12:45-1:45 PM Peak Pd	Analysis Year	2020 With-Action Alt 2
		Project ID	Charleston EIS

Volume and Timing Input												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Number of Lanes, N _l	1	1			1	1				2		1
Lane Group	L	T			T	R				L		R
Volume, V (vph)	888	484			517	1150				241		215
% Heavy Vehicles, %HV	1	1			1	1				1		1
Peak-Hour Factor, PHF	0.97	0.96			0.94	0.97				0.92		0.92
Pretimed (P) or Actuated (A)	P	P			P	P				P		P
Start-up Lost Time, l ₁	2.0	2.0			2.0	2.0				2.0		2.0
Extension of Effective Green, e	3.0	2.0			2.0	2.0				2.0		2.0
Arrival Type, AT	3	3			3	3				3		3
Unit Extension, UE	3.0	3.0			3.0	3.0				3.0		3.0
Filtering/Metering, I	0.508	0.508			0.176	0.176				1.000		1.000
Initial Unmet Demand, Q _b	0.0	0.0			0.0	0.0				0.0		0.0
Ped / Bike / RTOR Volumes	0	0		0	0	0	0	0		0	0	0
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
Parking / Grade / Parking	N	0	Y	N	0	N	N	0	N	N	0	N
Parking Maneuvers, N _m			5									
Buses Stopping, N _b	0	0			0	0				0		0
Min. Time for Pedestrians, G _p	14.6			24.6			3.2			20.1		
Phasing	EB Only	EW Perm	03	04	SB Only	06	07	08				
Timing	G = 37.0	G = 22.0	G =	G =	G = 16.0	G =	G =	G =				
	Y = 5	Y = 5	Y =	Y =	Y = 5	Y =	Y =	Y =				
Duration of Analysis, T = 0.25							Cycle Length, C = 90.0					

Lane Group Capacity, Control Delay, and LOS Determination												
	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Adjusted Flow Rate, v	915	504			550	1186				262		234
Lane Group Capacity, c	895	1170			460	391				576		962
v/c Ratio, X	1.02	0.43			1.20	3.03				0.45		0.24
Total Green Ratio, g/C	0.72	0.71			0.24	0.24				0.18		0.64
Uniform Delay, d ₁	21.4	5.4			34.0	34.0				33.1		6.7
Progression Factor, PF	1.000	1.000			1.000	1.000				1.000		1.000
Delay Calibration, k	0.50	0.50			0.50	0.50				0.50		0.50
Incremental Delay, d ₂	27.3	0.6			92.1	916.2				2.6		0.6
Initial Queue Delay, d ₃	0.0	0.0			0.0	0.0				0.0		0.0
Control Delay	48.7	6.0			126.1	950.2				35.7		7.3
Lane Group LOS	D	A			F	F				D		A
Approach Delay	33.5			689.1						22.3		
Approach LOS	C			F						C		
Intersection Delay	343.7			X _C = 1.47			Intersection LOS			F		

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/9/2013	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 With-Action Alt 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4		5	6	7	8
EB	Left	P					NB Left	P		
	Thru	P					NB Thru	P		
	Right	P					NB Right	P		
	Peds	X					NB Peds	X		
WB	Left	P					SB Left	P		
	Thru	P					SB Thru	P		
	Right	P					SB Right	P		
	Peds	X					SB Peds	X		
NB	Right					EB	Right			
SB	Right					WB	Right			
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	736	1471	0.96	0.50	46.8	D		
TR	1066	2132	0.05	0.50	11.6	B	44.6	D

LTR	1633	3266	0.06	0.50	11.7	B	11.7	B
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LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
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LT	544	1399	0.17	0.39	18.5	B	501.2	F
R	622	1599	2.12	0.39	534.2	F		

Intersection Delay = 326.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	178	12	0	0	13	16	0	0	1	23	0	436
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	710	48			99			1			90	1316
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000
Peds Bikes	0	0	0	0	0		0	0		0	0	
Buses	0	0		0			0			0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0			0.0			0.0	0.0	
Arriv. Type	3	3		3			3			3	3	
Unit Ext.	3.0	3.0		3.0			3.0			3.0	3.0	
I Factor		0.967		1.000			1.000			0.855		
Lost Time	2.0	2.0		2.0			2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0			2.0			2.0	2.0	
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0						35.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	682	46	0	0	46	58	0	0	1	84	0	1622
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	710	48	0	0	51	48	0	0	1	90	0	1316
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	710	48			99			1			90	1316
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR			LTR			LTR		LT	R
So	1900	1900			1900			1900		1900	1900
Lanes	0	2	0	0	2	0	0	2	0	0	1
fW	1.133	1.133			0.983			1.000		1.000	1.000
fHV	0.990	0.990			0.990			0.990		0.990	0.990
fG	1.000	1.000			1.000			1.000		1.000	1.000
fP	1.000	1.000			1.000			1.000		1.000	1.000
fBB	1.000	1.000			1.000			1.000		1.000	1.000
fA	1.000	1.000			1.000			1.000		1.000	1.000
fLU	1.000	1.000			0.952			0.952		1.000	1.000
fRT		1.000			0.927			0.850		1.000	0.850
fLT	0.690	1.000			1.000			1.000		0.744	
Sec.											
fLpb	1.000	1.000			1.000			1.000		1.000	
fRpb		1.000			1.000			1.000		1.000	1.000
S	1471	2132			3266			3045		1399	1599
Sec.											

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	DefL	710	1471	# 0.48	0.50	736	0.96
Prot							
Perm							
Thru	TR	48	2132	0.02	0.50	1066	0.05
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	99	3266	0.03	0.50	1633	0.06
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1	3045	0.00	0.39	1184	0.00
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	90	1399	0.06	0.39	544	0.17
Right	R	1316	1599	# 0.82	0.39	622	2.12

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.31
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.47

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.96	0.50	21.7	1.000	736	0.50	25.1	0.0	46.8	D			
TR	0.05	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	44.6	D	
Westbound													
LTR	0.06	0.50	11.6	1.000	1633	0.50	0.1	0.0	11.7	B	11.7	B	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.17	0.39	18.0	1.000	544	0.50	0.6	0.0	18.5	B	501.2	F	

R 2.12 0.39 27.5 1.000 622 0.50 506.7 0.0 534.2 F

Intersection delay = 326.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	45.0			
Opposing effective green time, go (s)	45.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	710			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	99			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	17.75			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.30			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.45			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.690			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		45.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		45.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	90
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	48	90	1
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.25
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.60	2.25	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	45.00	35.00	32.77
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.04	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.744

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	99	48	90	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	45.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	45.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.485	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00	22.5	21.7	0.00	0.0	0.0	46.8
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.5	11.6	0.00	0.0	0.0	11.7
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	18.0	0.00	0.0	0.0	18.5
R	0.0	0.00	27.5	27.5	0.00	173.5	0.0	534.2
Intersection Delay			326.7	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	710	48			51				0				90	1316	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1471	2132			1715				1599				1399	1599	
LnCapacity	736	1066			857				621				544	622	
Flow Ratio	0.5	0.0			0.0				0.0				0.1	0.8	
v/c Ratio	0.96	0.05			0.06				0.00				0.17	2.12	
Grn Ratio	0.50	0.50			0.50				0.39				0.39	0.39	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	17.1	0.6			0.7				0.0				1.5	32.9	
kB	0.9	1.2			1.0				0.8				0.6	0.7	
Q2	7.4	0.1			0.1				0.0				0.1	88.1	
Q Average	24.6	0.7			0.7				0.0				1.6	121.0	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	29.5	0.9			0.9				0.0				2.0	145	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	34.4	1.1			1.2				0.0				2.6	169	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	36.9	1.3			1.4				0.0				3.0	181	
QSRatio															
95th Percentile Output:															
fB%	1.6	2.5			2.5				2.6				2.3	1.6	
BOQ	39.5	1.7			1.8				0.0				3.7	194	
QSRatio															
98th Percentile Output:															
fB%	1.7	3.0			3.0				3.2				2.8	1.7	
BOQ	42.0	2.0			2.2				0.0				4.5	206	
QSRatio															

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Bricktown Ctr Rd @ Vets Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Volume	434		35				5	333			870	907
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	19.0				31.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	573	1811	0.89	0.32	36.6	D	35.4	D
R	497	1568	0.06	0.32	14.5	B		
Westbound								

Northbound

LT 1449 2805 0.27 0.52 8.6 A 8.6 A

Southbound

TR 1937 3749 1.03 0.52 37.5 D 37.5 D

Intersection Delay = 33.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Bricktown Ctr Rd @ Vets Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Bricktown Center Road N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	434		35				5	333		870	907	
% Heavy Veh	3		3				1	1		1	1	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
PK 15 Vol	128		10				2	95		244	255	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat	1900		1900					1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
LGConfig	L		R					LT			TR	
Lane Width	13.0		12.0					11.5			16.0	
RTOR Vol			9									0
Adj Flow	511		31					384			1997	
%InSharedLn												
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.510	
Peds Bikes	0			0						0	0	
Buses	0		0					0			0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0				0.0			0.0		
Arriv. Type	3		3				3			3		
Unit Ext.	3.0		3.0				3.0			3.0		
I Factor		0.892						0.995			0.487	
Lost Time	2.0		2.0				2.0			2.0		
Ext of g	2.0		2.0				2.0			2.0		
Ped Min g		21.8			20.3						19.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		19.0							31.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	434		35				5	333		870	907	
PHF	0.85		0.85				0.88	0.88		0.89	0.89	
Adj flow	511		31				6	378		978	1019	
No. Lanes	1	0	1	0	0	0	0	2	0	0	2	0
Lane group	L		R					LT			TR	
Adj flow	511		31					384			1997	
Prop LTs								0.016			0.000	
Prop RTs			1.000					0.000			0.510	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R			LT		TR	
So	1900	1900			1900		1900	
Lanes	1	0	1	0	2	0	2	0
fW	1.033	1.000			0.983		1.133	
fHV	0.971	0.971			0.990		0.990	
fG	1.000	1.000			1.000		1.000	
fP	1.000	1.000			1.000		1.000	
fBB	1.000	1.000			1.000		1.000	
fA	1.000	1.000			1.000		1.000	
fLU	1.000	1.000			0.952		0.952	
fRT		0.850			1.000		0.923	
fLT	0.950				0.797		1.000	
Sec.								
fLpb	1.000				1.000		1.000	
fRpb		1.000			1.000		1.000	
S	1811	1568			2805		3749	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	511	1811	# 0.28	0.32	573	0.89
Prot							
Perm							
Thru							
Right	R	31	1568	0.02	0.32	497	0.06
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	384	2805	0.14	0.52	1449	0.27
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1997	3749	# 0.53	0.52	1937	1.03
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.81
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.98

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.89	0.32	19.5	1.000	573	0.50	17.1	0.0	36.6	D	35.4	D	
R	0.06	0.32	14.3	1.000	497	0.50	0.2	0.0	14.5	B			
Westbound													
Northbound													
LT	0.27	0.52	8.1	1.000	1449	0.50	0.4	0.0	8.6	A	8.6	A	
Southbound													
TR	1.03	0.52	14.5	1.000	1937	0.50	23.0	0.0	37.5	D	37.5	D	

Intersection delay = 33.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLTC/3600

Opposing lane util. factor, fLUo 0.952 0.952

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC ** b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			31.0	
Effective permitted green time for LT lane group, g(s)			31.0	
Opposing effective green time, go (s)			31.0	
Number of lanes in LT lane group, N			2	

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	6
Proportion of LT in LT lane group, PLT	0.016 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	1997
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	0.10
Opposing lane util. factor, fLUo	0.952 0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	17.48
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.48
gq, (see Exhibit C16-4,5,6,7,8)	31.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.00
n=Max(gq-gf)/2,0)	4.91
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03
EL1 (refer to Exhibit C16-3)	10.56
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.68
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.797

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			31.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			31.00	
Eff. ped. green consumed by opp. veh. queue, gq/gp			1.000	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			1997	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.016	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		31.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		31.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.510
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	20.5	19.5	0.00	0.0	0.0	36.6
	0.0						0.0	
R	0.0	0.00	20.5	14.3	0.00	0.0	0.0	14.5
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	14.5	8.1	0.00	0.0	0.0	8.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	14.5	14.5	0.00	15.0	0.0	37.5
	0.0						0.0	
Intersection Delay			33.3	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound			Northbound		Southbound	
LaneGroup	L	R				LT		TR	
Init Queue	0.0	0.0				0.0		0.0	
Flow Rate	511	31				201		1048	
So	1900	1900				1900		1900	
No.Lanes	1	0	1	0	0	0	2	0	0
SL	1811	1568				1473		1969	
LnCapacity	573	497				761		1017	
Flow Ratio	0.3	0.0				0.1		0.5	
v/c Ratio	0.89	0.06				0.26		1.03	
Grn Ratio	0.32	0.32				0.52		0.52	
I Factor		0.892				0.995		0.487	
AT or PVG	3	3				3		3	
Pltn Ratio	1.00	1.00				1.00		1.00	
PF2	1.00	1.00				1.00		1.00	
Q1	8.1	0.4				1.9		17.5	
kB	0.5	0.5				0.7		0.4	
Q2	3.1	0.0				0.3		9.6	
Q Average	11.2	0.4				2.1		27.1	
Q Spacing	25.0	25.0				25.0		25.0	
Q Storage	0	0				0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.3				1.3		1.2	
BOQ	13.5	0.5				2.7		32.5	
QSRatio									
85th Percentile Output:									
fB%	1.4	1.7				1.6		1.4	
BOQ	16.0	0.7				3.4		38.0	
QSRatio									
90th Percentile Output:									
fB%	1.6	2.0				1.8		1.5	
BOQ	17.4	0.8				3.9		40.7	
QSRatio									
95th Percentile Output:									
fB%	1.7	2.5				2.3		1.6	
BOQ	19.1	1.0				4.8		43.5	
QSRatio									
98th Percentile Output:									
fB%	1.9	3.1				2.7		1.7	
BOQ	20.8	1.2				5.7		46.3	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			LT			L	LTR				
Volume	1	0		795	2		5			28	982	1
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	784	1881	0.00	0.42	10.2	B	10.2	B
----	-----	------	------	------	------	---	------	---

Westbound

L	607	1458	1.08	0.42	77.3	E		
LT	584	1401	0.38	0.42	13.9	B	61.3	E

Northbound

L	125	300	0.05	0.42	11.1	B	11.1	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	2041	4898	0.56	0.42	14.4	B	14.4	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 34.8 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		795	2		5			28	982	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		218	1		2			8	276	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	1			656	220		6			1135		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.993		1.000				0.027	
Prop RTs	0.000			0.000						0.001		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		795	2		5			28	982	1
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	1	0		874	2		6			31	1103	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	1			656	220		6			1135		
Prop LTs	0.000			1.000 0.993			1.000			0.027		
Prop RTs	0.000			0.000						0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.757 0.728		0.169		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1458 1401		300		4898	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1	1881	0.00	0.42	784	0.00
Right							
Westbound							
Prot							
Perm							
Left	L	656	1458	# 0.45	0.42	607	1.08
Prot							
Perm							
Thru	LT	220	1401	0.16	0.42	584	0.38
Right							
Northbound							
Prot							
Perm							
Left	L	6	300	0.02	0.42	125	0.05
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1135	4898	# 0.23	0.42	2041	0.56
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.68

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
TR	0.00	0.42	10.2	1.000	784	0.50	0.0	0.0	10.2	B	10.2	B	
Westbound													
L	1.08	0.42	17.5	1.000	607	0.50	59.8	0.0	77.3	E			
LT	0.38	0.42	12.1	1.000	584	0.50	1.8	0.0	13.9	B	61.3	E	
Northbound													
L	0.05	0.42	10.4	1.000	125	0.50	0.7	0.0	11.1	B			
											11.1	B	
Southbound													
LTR	0.56	0.42	13.3	1.000	2041	0.50	1.1	0.0	14.4	B	14.4	B	

Intersection delay = 34.8 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0	25.0	
Effective permitted green time for LT lane group, g(s)		25.0	25.0	
Opposing effective green time, go (s)		25.0	25.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		656	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		1	1135	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		10.93	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.02	6.94	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	7.22	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		25.00	17.78	
n=Max(gq-gf)/2,0)		0.00	3.61	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	4.21	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.48	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.16	0.16	
gdifff=max(gq-gf,0)		0.00	7.22	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.17	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.757	0.169	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 60.0 sec				
Total actual green time for LT lane group, G (s)		25.0		
Effective permitted green time for LT lane group, g(s)		25.0		
Opposing effective green time, go (s)		25.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	218		
Proportion of LT in LT lane group, PLT	0.000	0.993	0.027
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.63		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	25.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16		
gdif=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.728		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	1		656	220	6		416	
So	1900		1900	1900	1900		1900	
No.Lanes	0	1	0	1	0	0	0	3
SL	1881		1458	1401	300		1798	
LnCapacity	784		607	584	125		749	
Flow Ratio	0.0		0.4	0.2	0.0		0.2	
v/c Ratio	0.00		1.08	0.38	0.05		0.56	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000			0.971		0.951	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		10.9	2.5	0.1		5.3	
kB	0.7		0.6	0.6	0.2		0.7	
Q2	0.0		10.7	0.3	0.0		0.9	
Q Average	0.0		21.6	2.9	0.1		6.1	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	0.0		25.9	3.6	0.1		7.5	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7		1.5	
BOQ	0.0		30.3	4.5	0.1		9.1	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0		1.6	
BOQ	0.0		32.5	5.1	0.1		10.1	
QSRatio								
95th Percentile Output:								
fB%	2.6		1.6	2.2	2.6		1.9	
BOQ	0.0		34.8	6.2	0.2		11.6	
QSRatio								
98th Percentile Output:								
fB%	3.2		1.7	2.5	3.2		2.1	
BOQ	0.0		37.1	7.3	0.2		13.1	
QSRatio								

ERROR MESSAGES

No errors to report.

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Englewood Ave & Vets Rd W RT
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Englewood Avenue
North/South Street: Veterans Rd W Right Turn Bay
Intersection Orientation: EW Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Eastbound			Westbound		
		1	2	3	4	5	6
		L	T	R	L	T	R

Volume	28				
Peak-Hour Factor, PHF	0.75				
Hourly Flow Rate, HFR	37				
Percent Heavy Vehicles	--	--		--	--
Median Type/Storage	Undivided		/		
RT Channelized?					
Lanes	1				
Configuration	T				
Upstream Signal?	No			No	

Minor Street:	Approach Movement	Northbound			Southbound		
		7 L	8 T	9 R	10 L	11 T	12 R

Volume	762		
Peak Hour Factor, PHF	0.88		
Hourly Flow Rate, HFR	865		
Percent Heavy Vehicles	0		
Percent Grade (%)	0		0
Flared Approach: Exists?/Storage		/	/
Lanes	1		
Configuration	R		

Delay, Queue Length, and Level of Service

Approach	EB	WB	Northbound			Southbound		
Movement	1	4	7	8	9	10	11	12
Lane Config					R			

v (vph)		865
C(m) (vph)		1041
v/c		0.83
95% queue length		10.10
Control Delay		22.8
LOS		C
Approach Delay	22.8	
Approach LOS	C	

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----TWO-WAY STOP CONTROL(TWSC) ANALYSIS-----

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Vets Rd W RT
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Veterans Rd W Right Turn Bay
 Intersection Orientation: EW Study period (hrs): 0.25

-----Vehicle Volumes and Adjustments-----

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		28				
Peak-Hour Factor, PHF		0.75				
Peak-15 Minute Volume		9				
Hourly Flow Rate, HFR		37				
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes		1				
Configuration		T				
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume			762			
Peak Hour Factor, PHF			0.88			
Peak-15 Minute Volume			216			
Hourly Flow Rate, HFR			865			
Percent Heavy Vehicles			0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes			1			
Configuration			R			

-----Pedestrian Volumes and Adjustments-----

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)					6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)					0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)					0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage					6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)					3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)					0			
t(f)					3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
V c,x					37			
s								
Px								
V c,u,x								
C r,x								
C plat,x								
Two-Stage Process	7		8		10		11	

V(c,x)
S
P(x)
V(c,u,x)

C(r,x)
C(plat,x)

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows	37	
Potential Capacity	1041	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1041	
Probability of Queue free St.	0.17	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	0.17
Movement Capacity		

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 0.17
Movement Capacity

Results for Two-stage process:
a
y
C t

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)			865			
Movement Capacity (vph)			1041			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep			1041			
Volume			865			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9 R	10	11	12
Lane Config								
v (vph)					865			
C(m) (vph)					1041			
v/c					0.83			
95% queue length					10.10			
Control Delay					22.8			
LOS					C			
Approach Delay				22.8				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

ALL-WAY STOP CONTROL(AWSC) ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd & Veterans Rd W
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road West

Worksheet 2 - Volume Adjustments and Site Characteristics

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	91	35	376	66	0	0	0	0	17	119	23
% Thrus Left Lane												50

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	TR		LT				LT TR	
PHF	0.75		0.85				0.89 0.89	
Flow Rate	167		519				85 92	
% Heavy Veh	2		4				0 0	
No. Lanes		1		1				2
Opposing-Lanes		1		1				0
Conflicting-lanes		2		2				1
Geometry group		2		2				1
Duration, T	0.25	hrs.						

Worksheet 3 - Saturation Headway Adjustment Worksheet

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	167		519				85	92
Left-Turn	0		442				19	0
Right-Turn	46		0				0	25
Prop. Left-Turns	0.0		0.9				0.2	0.0
Prop. Right-Turns	0.3		0.0				0.0	0.3
Prop. Heavy Vehicle	0.0		0.0				0.0	0.0
Geometry Group		2		2				1
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2				0.2

_____Worksheet 4 - Departure Headway and Service Time_____

_____Worksheet 5 - Capacity and Level of Service_____

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

-----ALL-WAY STOP CONTROL(AWSC) ANALYSIS-----

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Sharrotts Rd @ Veterans Rd E
Jurisdiction: Staten Island, NY
Units: U. S. Customary
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
East/West Street: Sharrotts Road
North/South Street: Veterans Road East

-----Worksheet 2 - Volume Adjustments and Site Characteristics-----

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	26	82	0	0	387	24	53	106	138	0	0	0
% Thrus Left Lane									50			

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Configuration	LT		TR		LT		TR	
PHF	0.75		0.85		0.95		0.95	
Flow Rate	143		483		110		200	
% Heavy Veh	2		2		1		1	
No. Lanes		1		1		2		
Opposing-Lanes		1		1		0		
Conflicting-lanes		2		2		1		
Geometry group		2		2		1		
Duration, T	0.25	hrs.						

-----Worksheet 3 - Saturation Headway Adjustment Worksheet-----

	Eastbound		Westbound		Northbound		Southbound	
	L1	L2	L1	L2	L1	L2	L1	L2
Flow Rates:								
Total in Lane	143		483		110	200		
Left-Turn	34		0		55	0		
Right-Turn	0		28		0	145		
Prop. Left-Turns	0.2		0.0		0.5	0.0		
Prop. Right-Turns	0.0		0.1		0.0	0.7		
Prop. Heavy Vehicle	0.0		0.0		0.0	0.0		
Geometry Group		2		2		1		
Adjustments Exhibit 17-33:								
hLT-adj		0.2		0.2		0.2		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	217	376	199	0	84	15	712	65	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	21.0				29.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	557	1592	1.42	0.35	218.1	F	181.1	F
R	560	1599	0.32	0.35	15.7	B		

Westbound

LTR	560	1601	0.21	0.35	14.6	B	14.6	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2266	4688	0.37	0.48	10.2	B	10.2	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 96.3 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	217	376	199	0	84	15	712	65	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	72	125	66	0	25	5	191	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		790	177		119			839				
%InSharedLn												
Prop LTs		0.366			0.000			0.913				
Prop RTs		0.000	1.000		0.151			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		21.0							29.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	217	376	199	0	84	15	712	65	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	289	501	177	0	101	18	766	70	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	790 177			119			839					
Prop LTs	0.366			0.000			0.913					
Prop RTs	0.000 1.000			0.151			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.980			0.999	
fLT	0.819			1.000			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1592	1599		1601			4688	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
LT	1.42	0.35	19.5	1.000	557	0.50	198.6	0.0	218.1	F	181.1	F
R	0.32	0.35	14.3	1.000	560	0.50	1.5	0.0	15.7	B		
Westbound												
LTR	0.21	0.35	13.7	1.000	560	0.50	0.9	0.0	14.6	B	14.6	B
Northbound												
LTR	0.37	0.48	9.8	1.000	2266	0.50	0.5	0.0	10.2	B	10.2	B
Southbound												

Intersection delay = 96.3 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)	21.0	21.0		
Effective permitted green time for LT lane group, g(s)	21.0	21.0		
Opposing effective green time, go (s)	21.0	21.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	289	0	
Proportion of LT in LT lane group, PLT	0.366	0.000	0.913
Proportion of LT in opposing flow, PLTo	0.00	0.37	
Adjusted opposing flow rate, Vo (veh/h)	119	790	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.82	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.98	13.17	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.65	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	0.27	17.31	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	20.73	3.69	
n=Max(gq-gf)/2,0)	0.14	8.66	
PTHo=1-PLTo	1.00	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.00	
EL1 (refer to Exhibit C16-3)	1.56	3.05	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.68	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	17.31	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.18	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.819	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.27	17.31		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.013	0.824		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	119	790	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.366	0.000	0.913	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	21.0	21.0	29.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	21.0	21.0	29.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.151	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.5	19.5	0.00	58.3	0.0	218.1
R	0.0	0.00	19.5	14.3	0.00	0.0	0.0	15.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.5	13.7	0.00	0.0	0.0	14.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	9.8	0.00	0.0	0.0	10.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			96.3	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	790	177	119		308			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1592	1599	1601		1720			
LnCapacity	557	560	560		831			
Flow Ratio	0.5	0.1	0.1		0.2			
v/c Ratio	1.42	0.32	0.21		0.37			
Grn Ratio	0.35	0.35	0.35		0.48			
I Factor	0.997		0.993		0.967			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	13.2	2.2	1.4		3.2			
kB	0.6	0.6	0.6		0.7			
Q2	30.9	0.3	0.2		0.4			
Q Average	44.1	2.4	1.5		3.7			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.2			
BOQ	52.9	3.1	2.0		4.6			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.5			
BOQ	61.8	3.8	2.5		5.7			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.8	1.9		1.7			
BOQ	66.2	4.4	2.9		6.4			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.2	2.3		2.1			
BOQ	70.6	5.4	3.6		7.6			
QSRatio								
98th Percentile Output:								
fB%	1.7	2.6	2.8		2.4			
BOQ	75.0	6.3	4.3		8.9			
QSRatio								

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Englewood Avenue

Inter.: Englewood Av & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig	LR						LT			TR		
Volume	323		56				17	402		382	82	
Lane Width		16.0						14.0		16.0		
RTOR Vol			0								0	

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	16.0				34.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	468	1754	0.88	0.27	40.6	D	40.6	D
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	1110	1959	0.41	0.57	8.4	A	8.4	A
----	------	------	------	------	-----	---	-----	---

Southbound

TR	1179	2081	0.43	0.57	8.5	A	8.5	A
----	------	------	------	------	-----	---	-----	---

Intersection Delay = 18.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Av & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	323		56				17	402		382	82	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
PK 15 Vol	88		15				5	109		105	23	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X									
NumPark			5									
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						14.0			16.0	
RTOR Vol			0									0
Adj Flow		412						455			510	
%InSharedLn												
Prop LTs		0.852						0.040			0.000	
Prop RTs		0.148						0.000			0.176	
Peds Bikes	0			0						0		0
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.937						0.937			0.937	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		14.9			15.5						17.5	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds							Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	323		56				17	402		382	82	
PHF	0.92		0.92				0.92	0.92		0.91	0.91	
Adj flow	351		61				18	437		420	90	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		412						455			510	
Prop LTs		0.852						0.040			0.000	
Prop RTs	0.148						0.000			0.176		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.067			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						1.000			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.980						1.000			0.976		
fLT	0.959						0.976			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1754						1959			2081		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	412	1754	# 0.23	0.27	468	0.88
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	455	1959	0.23	0.57	1110	0.41
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	510	2081	# 0.25	0.57	1179	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.48
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.88	0.27	21.1	1.000	468	0.50	19.5	0.0	40.6	D	40.6	D
Westbound												
Northbound												
LT	0.41	0.57	7.3	1.000	1110	0.50	1.1	0.0	8.4	A	8.4	A
Southbound												
TR	0.43	0.57	7.5	1.000	1179	0.50	1.1	0.0	8.5	A	8.5	A

Intersection delay = 18.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			34.0	
Effective permitted green time for LT lane group, g(s)			34.0	
Opposing effective green time, go (s)			34.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		18	
Proportion of LT in LT lane group, PLT	0.852	0.040	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		510	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.30	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.50	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		17.7	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.43	
gq, (see Exhibit C16-4,5,6,7,8)		5.40	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		16.28	
n=Max(gq-gf)/2,0)		0.00	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.04	
EL1 (refer to Exhibit C16-3)		2.32	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.06	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.98	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.976	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			34.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			5.40	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.159	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			510	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			1	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			0.040	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		34.0
Conflicting pedestrian volume, Vped (p/h)		0
Conflicting bicycle volume, Vbic (bicycles/h)		0
Vpedg		0
OCCpedg		0.000
Effective green, g (s)		34.0
Vbicg		0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.176
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.1	0.00	0.0	0.0	40.6
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	13.0	7.3	0.00	0.0	0.0	8.4
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	13.0	7.5	0.00	0.0	0.0	8.5
	0.0						0.0	
Intersection Delay			18.1	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	412						455			510		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1754						1959			2081		
LnCapacity	468						1110			1179		
Flow Ratio	0.2						0.2			0.2		
v/c Ratio	0.88						0.41			0.43		
Grn Ratio	0.27						0.57			0.57		
I Factor	0.937						0.937			0.937		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	6.6						4.3			4.9		
kB	0.5						0.9			0.9		
Q2	2.6						0.6			0.7		
Q Average	9.1						4.9			5.6		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	11.1						6.0			6.9		
QSRatio												
85th Percentile Output:												
fB%	1.4						1.5			1.5		
BOQ	13.2						7.4			8.3		
QSRatio												
90th Percentile Output:												
fB%	1.6						1.7			1.7		
BOQ	14.4						8.2			9.3		
QSRatio												
95th Percentile Output:												
fB%	1.8						2.0			1.9		
BOQ	16.1						9.6			10.7		
QSRatio												
98th Percentile Output:												
fB%	1.9						2.3			2.2		
BOQ	17.7						11.1			12.2		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Sharrotts Road

Inter.: Sharrotts Rd & Bloomingdale Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Volume	155		66				43	619			407	368
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds	X				Peds			
WB Left					SB Left			
Thru					Thru	P		
Right					Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	20.0				30.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LR	577	1730	0.51	0.33	19.1	B	19.1	B
----	-----	------	------	------	------	---	------	---

Westbound

Northbound

LT	767	1533	0.94	0.50	32.5	C	32.5	C
----	-----	------	------	------	------	---	------	---

Southbound

TR	1000	1999	0.83	0.50	20.0+	C	20.0+	C
----	------	------	------	------	-------	---	-------	---

Intersection Delay = 24.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Sharrotts Rd & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Sharrotts Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	155		66				43	619		407	368	
% Heavy Veh	1		1				1	1		1	1	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
PK 15 Vol	52		22				12	168		112	101	
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900			1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
LGConfig		LR						LT			TR	
Lane Width		16.0						16.0			16.0	
RTOR Vol			0									20
Adj Flow		295						720			829	
%InSharedLn												
Prop LTs		0.702						0.065			0.000	
Prop RTs		0.298						0.000			0.461	
Peds Bikes	0	0		0						0	0	
Buses		0						0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0			0.0	
Arriv. Type		3						3			3	
Unit Ext.		3.0						3.0			3.0	
I Factor		0.932						0.850			0.905	
Lost Time		2.0						2.0			2.0	
Ext of g		2.0						2.0			2.0	
Ped Min g		18.6			18.6						16.6	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
WB	Left						SB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		20.0							30.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	155		66				43	619		407	368	
PHF	0.75		0.75				0.92	0.92		0.91	0.91	
Adj flow	207		88				47	673		447	382	
No. Lanes	0	0	0	0	0	0	0	1	0	0	1	0
Lane group	LR						LT			TR		
Adj flow		295						720			829	
Prop LTs		0.702						0.065			0.000	
Prop RTs		0.298						0.000			0.461	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LR						LT			TR		
So	1900						1900			1900		
Lanes 0	0	0	0	0	0	0	1	0	0	1	0	0
fW	1.133						1.133			1.133		
fHV	0.990						0.990			0.990		
fG	1.000						1.000			1.000		
fP	0.875						0.875			1.000		
fBB	1.000						1.000			1.000		
fA	1.000						1.000			1.000		
fLU	1.000						1.000			1.000		
fRT	0.960						1.000			0.938		
fLT	0.966						0.822			1.000		
Sec.												
fLpb	1.000						1.000			1.000		
fRpb	1.000						1.000			1.000		
S	1730						1533			1999		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	295	1730	# 0.17	0.33	577	0.51
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	720	1533	# 0.47	0.50	767	0.94
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	829	1999	0.41	0.50	1000	0.83
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.64
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LR	0.51	0.33	16.1	1.000	577	0.50	3.0	0.0	19.1	B	19.1	B
Westbound												
Northbound												
LT	0.94	0.50	14.1	1.000	767	0.50	18.3	0.0	32.5	C	32.5	C
Southbound												
TR	0.83	0.50	12.8	1.000	1000	0.50	7.2	0.0	20.0+	C	20.0+	C

Intersection delay = 24.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)			30.0	
Effective permitted green time for LT lane group, g(s)			30.0	
Opposing effective green time, go (s)			30.0	
Number of lanes in LT lane group, N			1	

Number of lanes in opposing approach, No		1	
Adjusted LT flow rate, VLT (veh/h)		47	
Proportion of LT in LT lane group, PLT	0.702	0.065	0.000
Proportion of LT in opposing flow, PLTo		0.00	
Adjusted opposing flow rate, Vo (veh/h)		829	
Lost time for LT lane group, tL		5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600		0.78	
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.82	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		9.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]		0.50	
gq, (see Exhibit C16-4,5,6,7,8)		12.52	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		17.48	
n=Max(gq-gf)/2,0)		1.59	
PTHo=1-PLTo		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		0.07	
EL1 (refer to Exhibit C16-3)		3.17	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g		0.07	
gdifff=max(gq-gf,0)		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.82	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT		0.822	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0		30.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)			12.52	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.417	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)	0		829	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT			1.000	
Proportion of left turns, PLT	0.702		0.065	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0		30.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	20.0		30.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.298	0.461
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LR	0.0	0.00	20.0	16.1	0.00	0.0	0.0	19.1
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	15.0	14.1	0.00	0.0	0.0	32.5
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	15.0	12.8	0.00	0.0	0.0	20.0+
	0.0						0.0	
Intersection Delay			24.7	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LR						LT			TR		
Init Queue	0.0						0.0			0.0		
Flow Rate	295						720			829		
So	1900						1900			1900		
No.Lanes	0	0	0	0	0	0	0	1	0	0	1	0
SL	1730						1533			1999		
LnCapacity	577						767			1000		
Flow Ratio	0.2						0.5			0.4		
v/c Ratio	0.51						0.94			0.83		
Grn Ratio	0.33						0.50			0.50		
I Factor	0.932						0.850			0.905		
AT or PVG	3						3			3		
Pltn Ratio	1.00						1.00			1.00		
PF2	1.00						1.00			1.00		
Q1	4.0						11.3			11.8		
kB	0.5						0.6			0.8		
Q2	0.6						5.0			3.3		
Q Average	4.5						16.3			15.1		
Q Spacing	25.0						25.0			25.0		
Q Storage	0						0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.2						1.2			1.2		
BOQ	5.6						19.6			18.2		
QSRatio												
85th Percentile Output:												
fB%	1.5						1.4			1.4		
BOQ	6.9						23.0			21.3		
QSRatio												
90th Percentile Output:												
fB%	1.7						1.5			1.5		
BOQ	7.7						24.8			23.0		
QSRatio												
95th Percentile Output:												
fB%	2.0						1.6			1.6		
BOQ	9.1						26.7			24.9		
QSRatio												
98th Percentile Output:												
fB%	2.3						1.8			1.8		
BOQ	10.4						28.7			26.7		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		179	301	614	173	149	228		420		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	17.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	222	1668	0.12	0.13	23.7	C	113.1	F
R	220	1652	1.15	0.13	122.7	F		
Westbound								
LTR	1338	4723	0.93	0.28	28.4	C	28.4	C
Northbound								
L	139	416	1.17	0.33	144.5	F		
T	621	1863	0.40	0.33	17.1	B	67.5	E
Southbound								
TR	707	2121	0.69	0.33	21.4	C	21.4	C

Intersection Delay = 43.3 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		179	301	614	173	149	228		420	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		63	86	176	50	40	62		117	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		252		1251		162	248			486	
%InSharedLn												
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000		0.039		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	0			0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	17.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		179	301	614	173	149	228		420	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		252	346	706	199	162	248		467	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	27		252		1251		162	248			486	
Prop LTs					0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000			0.039	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.980		0.980	0.980	0.990	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	1.000	1.000	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.976			1.000	0.995	
fLT	0.950		0.986		0.223	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	1668	1652	4723		416	1863	2121	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	1668	0.02	0.13	222	0.12
Prot							
Perm							
Thru							
Right	R	252	1652	# 0.15	0.13	220	1.15
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1251	4723	# 0.26	0.28	1338	0.93
Right							
Northbound							
Prot							
Perm							
Left	L	162	416	# 0.39	0.33	139	1.17
Prot							
Perm							
Thru	T	248	1863	0.13	0.33	621	0.40
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	486	2121	0.23	0.33	707	0.69
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.81

Total lost time per cycle, L = 15.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.08

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.12	0.13	22.9	1.000	222	0.50	0.8	0.0	23.7	C	113.1	F	
R	1.15	0.13	26.0	1.000	220	0.50	96.7	0.0	122.7	F			
Westbound													
LTR	0.93	0.28	21.0	1.000	1338	0.50	7.4	0.0	28.4	C	28.4	C	
Northbound													
L	1.17	0.33	20.0	1.000	139	0.50	124.5	0.0	144.5	F	67.5	E	
T	0.40	0.33	15.4	1.000	621	0.50	1.8	0.0	17.1	B			
Southbound													
TR	0.69	0.33	17.3	1.000	707	0.50	4.1	0.0	21.4	C	21.4	C	

Intersection delay = 43.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			162	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			486	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLT/3600			2.70	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			8.10	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			10.83	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			9.17	
n=Max(gq-gf)/2,0)			5.41	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			2.06	
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.22	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.223	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			10.83	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.541	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			486	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)		17.0		20.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		17.0		20.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.159	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.9	0.00	0.0	0.0	23.7
	0.0						0.0	
R	0.0	0.00	26.0	26.0	0.00	8.0	0.0	122.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	21.0	0.00	0.0	0.0	28.4
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	20.0	0.00	5.8	0.0	144.5
T	0.0	0.00	20.0	15.4	0.00	0.0	0.0	17.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	17.3	0.00	0.0	0.0	21.4
	0.0						0.0	

Intersection Delay	43.3	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound	Northbound		Southbound	
LaneGroup	L	R	LTR	L	T	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	27	252	459	162	248	486	
So	1900	1900	1900	1900	1900	1900	
No.Lanes	1 0	1 0	3 0	1 1 0	0	1 0	
SL	1668	1652	1733	416	1863	2121	
LnCapacity	222	220	491	139	621	707	
Flow Ratio	0.0	0.2	0.3	0.4	0.1	0.2	
v/c Ratio	0.12	1.15	0.93	1.17	0.40	0.69	
Grn Ratio	0.13	0.13	0.28	0.33	0.33	0.33	
I Factor		0.717	0.483		0.917	0.747	
AT or PVG	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.4	4.2	7.5	2.7	3.2	7.0	
kB	0.2	0.2	0.3	0.2	0.6	0.5	
Q2	0.0	5.3	2.3	3.9	0.4	1.1	
Q Average	0.4	9.5	9.8	6.6	3.6	8.1	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	
Q S Ratio							
70th Percentile Output:							
fB%	1.3	1.2	1.2	1.2	1.2	1.2	
BOQ	0.6	11.5	11.8	8.1	4.4	9.8	
QSRatio							
85th Percentile Output:							
fB%	1.7	1.4	1.4	1.5	1.5	1.5	
BOQ	0.7	13.7	14.1	9.8	5.5	11.8	
QSRatio							
90th Percentile Output:							
fB%	2.0	1.6	1.6	1.6	1.7	1.6	
BOQ	0.8	14.9	15.3	10.8	6.2	12.9	
QSRatio							
95th Percentile Output:							
fB%	2.5	1.8	1.7	1.9	2.1	1.8	
BOQ	1.1	16.6	17.0	12.3	7.4	14.5	
QSRatio							
98th Percentile Output:							
fB%	3.1	1.9	1.9	2.1	2.4	2.0	
BOQ	1.3	18.2	18.7	13.9	8.7	16.1	
QSRatio							

ERROR MESSAGES

WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: S Service Rd & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig	LTR						LTR			L	TR	
Volume	31	33	5				3	346	152	314	537	47
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0					0				11

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left					SB Left	P		
Thru					Thru	P		
Right					Right	P		
Peds					Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	17.0				33.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 462 1630 0.20 0.28 17.3 B 17.3 B

Westbound

Northbound

LTR 972 1768 0.56 0.55 10.9 B 10.9 B

Southbound

L 448 815 0.78 0.55 19.0 B
 TR 1025 1863 0.62 0.55 11.1 B 13.9 B

Intersection Delay = 13.1 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: S Service Rd & Bloomingdale Rd
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 With-Action Alt 2
Project ID: Charleston EIS
E/W St: S Service Rd/Drumgoole Rd E N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	31	33	5				3	346	152	314	537	47
% Heavy Veh	2	2	2				2	2	2	1	1	1
PHF	0.76	0.76	0.76				0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	10	11	2				1	94	41	87	149	13
Hi Ln Vol												
% Grade		0						0			0	
Ideal Sat		1900						1900		1900	1900	
ParkExist			X						X			
NumPark			5						5			
No. Lanes	0	1	0	0	0	0	0	1	0	1	1	0
LGConfig		LTR						LTR		L	TR	
Lane Width		13.0						16.0		12.0	12.0	
RTOR Vol			0						0			11
Adj Flow		91						544		349	637	
%InSharedLn												
Prop LTS		0.451						0.006		1.000	0.000	
Prop RTS	0.077						0.303			0.063		
Peds Bikes	0	0		0			0	0		0	0	
Buses	0						0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0						0.0		0.0	0.0	
Arriv. Type		3						3		3	3	
Unit Ext.		3.0						3.0		3.0	3.0	
I Factor		1.000						0.899			0.644	
Lost Time		2.0						2.0		2.0	2.0	
Ext of g		2.0						2.0		2.0	2.0	
Ped Min g		17.5			16.9			12.6			12.9	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left						SB	Left	P	
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	31	33	5						3	346	152		314	537	47
PHF	0.76	0.76	0.76						0.92	0.92	0.92		0.90	0.90	0.90
Adj flow	41	43	7						3	376	165		349	597	40
No. Lanes	0	1	0		0	0	0		0	1	0		1	1	0
Lane group	LTR								LTR				L	TR	
Adj flow		91								544			349	637	
Prop LTs		0.451								0.006			1.000	0.000	
Prop RTs	0.077								0.303				0.063		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR						LTR			L	TR	
So	1900						1900			1900	1900	
Lanes	0	1	0	0	0	0	0	1	0	1	1	0
fW	1.033						1.133			1.000	1.000	
fHV	0.980						0.980			0.990	0.990	
fG	1.000						1.000			1.000	1.000	
fP	0.875						0.875			1.000	1.000	
fBB	1.000						1.000			1.000	1.000	
fA	1.000						1.000			1.000	1.000	
fLU	1.000						1.000			1.000	1.000	
fRT	0.990						0.959				0.991	
fLT	0.978						0.998			0.433	1.000	
Sec.												
fLpb	1.000						1.000			1.000	1.000	
fRpb	1.000						1.000				1.000	
S	1630						1768			815	1863	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	91	1630	# 0.06	0.28	462	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	544	1768	0.31	0.55	972	0.56
Right							
Southbound							
Prot							
Perm							
Left	L	349	815	# 0.43	0.55	448	0.78
Prot							
Perm							
Thru	TR	637	1863	0.34	0.55	1025	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.48
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.58

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.20	0.28	16.3	1.000	462	0.50	1.0	0.0	17.3	B	17.3	B	
Westbound													
Northbound													
LTR	0.56	0.55	8.8	1.000	972	0.50	2.1	0.0	10.9	B	10.9	B	
Southbound													
L	0.78	0.55	10.6	1.000	448	0.50	8.4	0.0	19.0	B			
TR	0.62	0.55	9.2	1.000	1025	0.50	1.8	0.0	11.1	B	13.9	B	

Intersection delay = 13.1 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				349
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				544
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.82
Opposing lane util. factor, fLUo		1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				9.07
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				6.37
gu=g-gq if gq>=gf, or = g-gf if gq<gf				26.63
n=Max(gq-gf)/2,0)				3.18
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.17
EL2=Max((1-Ptho**n)/Plto, 1.0)				3.16
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				6.37
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.43
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.433

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1

Number of lanes in opposing approach, No	1
Adjusted LT flow rate, VLT (veh/h)	3
Proportion of LT in LT lane group, PLT	0.451
Proportion of LT in opposing flow, PLTo	0.006 0.000
Adjusted opposing flow rate, Vo (veh/h)	0.00
Lost time for LT lane group, tL	637
Computation	5.00
LT volume per cycle, LTC=VLTC/3600	0.05
Opposing lane util. factor, fLUo	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.62
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.8
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.45
gq, (see Exhibit C16-4,5,6,7,8)	7.82
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.23
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01
EL1 (refer to Exhibit C16-3)	2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.06
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.998

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			33.0	33.0
Conflicting pedestrian volume, Vped (p/h)			0	0
Pedestrian flow rate, Vpedg (p/h)			0	0
OCCpedg			0.000	0.000
Opposing queue clearing green, gq (s)			7.82	6.37
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.237	0.193
OCCpedu			0.000	0.000
Opposing flow rate, Vo (veh/h)			637	544
OCCr			0.000	0.000
Number of cross-street receiving lanes, Nrec			1	1
Number of turning lanes, Nturn			1	1
ApbT			1.000	1.000
Proportion of left turns, PLT			0.006	1.000
Proportion of left turns using protected phase, PLTA			0.000	0.000
Left-turn adjustment, fLpb			1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	33.0
Conflicting pedestrian volume, Vped (p/h)	0		0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	0
Vpedg	0		0	0
OCCpedg	0.000		0.000	0.000
Effective green, g (s)	17.0		33.0	33.0
Vbicg	0		0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.077	0.303	0.063
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	21.5	16.3	0.00	0.0	0.0	17.3
	0.0						0.0	
Westbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	13.5	8.8	0.00	0.0	0.0	10.9
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	10.6	0.00	0.0	0.0	19.0
TR	0.0	0.00	13.5	9.2	0.00	0.0	0.0	11.1
	0.0						0.0	

Intersection Delay	13.1	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR						LTR			L	TR	
Init Queue	0.0						0.0			0.0	0.0	
Flow Rate	91						544			349	637	
So	1900						1900			1900	1900	
No.Lanes	0	1	0	0	0	0	0	1	0	1	1	0
SL	1630						1768			815	1863	
LnCapacity	462						972			448	1025	
Flow Ratio	0.1						0.3			0.4	0.3	
v/c Ratio	0.20						0.56			0.78	0.62	
Grn Ratio	0.28						0.55			0.55	0.55	
I Factor	1.000						0.899				0.644	
AT or PVG	3						3			3	3	
Pltn Ratio	1.00						1.00			1.00	1.00	
PF2	1.00						1.00			1.00	1.00	
Q1	1.2						5.9			4.6	7.3	
kB	0.5						0.8			0.3	0.6	
Q2	0.1						0.9			1.0	0.9	
Q Average	1.3						6.8			5.6	8.2	
Q Spacing	25.0						25.0			25.0	25.0	
Q Storage	0						0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3						1.2			1.2	1.2	
BOQ	1.6						8.4			6.9	10.0	
QSRatio												
85th Percentile Output:												
fB%	1.6						1.5			1.5	1.5	
BOQ	2.1						10.1			8.4	11.9	
QSRatio												
90th Percentile Output:												
fB%	1.9						1.6			1.7	1.6	
BOQ	2.4						11.1			9.3	13.0	
QSRatio												
95th Percentile Output:												
fB%	2.4						1.9			1.9	1.8	
BOQ	3.0						12.7			10.8	14.7	
QSRatio												
98th Percentile Output:												
fB%	2.9						2.1			2.2	2.0	
BOQ	3.6						14.2			12.3	16.3	
QSRatio												

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	8	8	18	293	18	105	13	346	241	86	443	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				40.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 631 1420 0.06 0.44 14.5 B 14.5 B

Westbound

L 578 1301 0.56 0.44 22.0 C
 T 808 1818 0.02 0.44 14.1 B 20.1 C
 R 601 1352 0.19 0.44 15.8 B

Northbound

LTR 743 1672 0.88 0.44 30.6 C 30.6 C

Southbound

LTR 606 1364 0.99 0.44 47.2 D 47.2 D

Intersection Delay = 33.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	8	18	293	18	105	13	346	241	86	443	8
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	81	5	29	4	94	65	24	123	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		41		326	20	117		652			597	
%InSharedLn												
Prop LTS		0.244		1.000	0.000			0.021			0.161	
Prop RTS		0.512			0.000	1.000		0.402			0.015	
Peds Bikes	50	0		0	0	0	50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		40.0						40.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	8	18	293	18	105	13	346	241	86	443	8
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	10	10	21	326	20	117	14	376	262	96	492	9
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	41			326 20 117			652			597		
Prop LTs	0.244			1.000 0.000			0.021			0.161		
Prop RTs	0.512			0.000 1.000			0.402			0.015		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.990	0.990	0.990	1.000		0.990		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	1.000		1.000	1.000	1.000	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.946		0.998		
fLT	0.964		0.730	1.000		0.985		0.729		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.997		
fRpb	0.971		1.000 1.000			0.977		1.000		
S	1420		1301	1818	1352	1672		1364		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1420	0.03	0.44	631	0.06
Right							
Westbound							
Prot							
Perm							
Left	L	326	1301	# 0.25	0.44	578	0.56
Prot							
Perm							
Thru	T	20	1818	0.01	0.44	808	0.02
Right	R	117	1352	0.09	0.44	601	0.19
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	652	1672	0.39	0.44	743	0.88
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	597	1364	# 0.44	0.44	606	0.99
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.06	0.44	14.3	1.000	631	0.50	0.2	0.0	14.5	B	14.5	B	
Westbound													
L	0.56	0.44	18.5	1.000	578	0.50	3.5	0.0	22.0	C			
T	0.02	0.44	14.0	1.000	808	0.50	0.1	0.0	14.1	B	20.1	C	
R	0.19	0.44	15.2	1.000	601	0.50	0.6	0.0	15.8	B			
Northbound													
LTR	0.88	0.44	22.8	1.000	743	0.50	7.8	0.0	30.6	C	30.6	C	
Southbound													
LTR	0.99	0.44	24.7	1.000	606	0.50	22.5	0.0	47.2	D	47.2	D	

Intersection delay = 33.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		40.0		
Effective permitted green time for LT lane group, g(s)		40.0		
Opposing effective green time, go (s)		40.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		326		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.24		
Adjusted opposing flow rate, Vo (veh/h)		41		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		8.15		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.56		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		40.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.76		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.730		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0		40.0	40.0
Effective permitted green time for LT lane group, g(s)	40.0		40.0	40.0
Opposing effective green time, go (s)	40.0		40.0	40.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	14	96
Proportion of LT in LT lane group, PLT	0.244	0.000	0.021
Proportion of LT in opposing flow, PLTo	0.00	0.16	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	597	652
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.35	2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	14.93	16.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.9	20.6	4.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.56	0.56	0.56
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.78	17.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.14	19.35	22.78
n=Max(gq-gf)/2,0)	0.00	0.00	6.61
PTHo=1-PLTo	1.00	0.84	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.24	0.02	0.16
EL1 (refer to Exhibit C16-3)	1.40	2.53	2.67
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	6.23
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	13.22
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96	0.98	0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.964	0.985	0.729

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	112	0	112
OCCpedg	0.000	0.056	0.000	0.056
Opposing queue clearing green, gq (s)	0.00	0.00	15.78	17.22
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.395	0.431
OCCpedu	0.000	0.056	0.000	0.044
Opposing flow rate, Vo (veh/h)	20	41	597	652
OCCr	0.000	0.053	0.000	0.018
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.982
Proportion of left turns, PLT	0.244	1.000	0.021	0.161
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.997

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0	40.0	40.0	40.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	112	0	112	0
OCCpedg	0.056	0.000	0.056	0.000
Effective green, g (s)	40.0	40.0	40.0	40.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.056	0.000	0.056	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.944	1.000	0.944	1.000
Proportion right-turns, PRT	0.512	1.000	0.402	0.015
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.977	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.0	14.3	0.00	0.0	0.0 0.0 0.0	14.5
Westbound								
L	0.0	0.00	25.0	18.5	0.00	0.0	0.0	22.0
T	0.0	0.00	25.0	14.0	0.00	0.0	0.0	14.1
R	0.0	0.00	25.0	15.2	0.00	0.0	0.0	15.8
Northbound								
LTR	0.0 0.0 0.0	0.00	25.0	22.8	0.00	0.0	0.0 0.0 0.0	30.6
Southbound								
LTR	0.0 0.0 0.0	0.00	25.0	24.7	0.00	0.0	0.0 0.0 0.0	47.2

Intersection Delay	33.1	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	41			326	20	117	652			597		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1420			1301	1818	1352	1672			1364		
LnCapacity	631			578	808	601	743			606		
Flow Ratio	0.0			0.3	0.0	0.1	0.4			0.4		
v/c Ratio	0.06			0.56	0.02	0.19	0.88			0.99		
Grn Ratio	0.44			0.44	0.44	0.44	0.44			0.44		
I Factor	1.000			0.887			0.516			0.500		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.6			6.0	0.3	1.8	14.8			14.7		
kB	0.8			0.7	0.9	0.7	0.5			0.4		
Q2	0.1			0.9	0.0	0.2	2.8			4.9		
Q Average	0.6			6.9	0.3	1.9	17.6			19.7		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	0.8			8.5	0.4	2.5	21.2			23.7		
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.7	1.6	1.4			1.4		
BOQ	1.1			10.2	0.5	3.1	24.8			27.7		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.6	2.0	1.8	1.5			1.5		
BOQ	1.2			11.2	0.6	3.6	26.7			29.7		
QSRatio												
95th Percentile Output:												
fB%	2.5			1.9	2.5	2.3	1.6			1.6		
BOQ	1.6			12.8	0.8	4.4	28.7			31.9		
QSRatio												
98th Percentile Output:												
fB%	3.0			2.1	3.1	2.7	1.7			1.7		
BOQ	1.9			14.4	0.9	5.3	30.7			34.1		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig	TR			LT			LR					
Volume	238		239	312		246	159		255			
Lane Width	16.0			16.0			11.0					
RTOR Vol			56						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		45.0					35.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	986	1971	0.55	0.50	17.5	B	17.5	B
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Westbound

LT	424	848	1.48	0.50	250.3	F	250.3	F
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Northbound

LR	557	1431	0.87	0.39	42.0	D	42.0	D
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Southbound

Intersection Delay = 113.0 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		238	239	312	246		159		255			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		76	77	88	69		47		75			
Hi Ln Vol												
% Grade		0		0			0					
Ideal Sat		1900		1900			1900					
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
LGConfig		TR			LT			LR				
Lane Width		16.0			16.0			11.0				
RTOR Vol			56						0			
Adj Flow		540			627			487				
%InSharedLn												
Prop LTs		0.000			0.560			0.384				
Prop RTs		0.435			0.000			0.616				
Peds Bikes		0						0		0		
Buses		2			0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0			0.0				
Arriv. Type		3			3			3				
Unit Ext.		3.0			3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0			2.0			2.0				
Ext of g		2.0			2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		238	239	312	246		159		255			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		305	235	351	276		187		300			
No. Lanes	0	1	0	0	1	0	0	0	0	0	0	0
Lane group		TR			LT			LR				
Adj flow		540			627			487				
Prop LTs		0.000			0.560			0.384				
Prop RTs		0.435			0.000			0.616				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	TR			LT			LR					
So	1900			1900			1900					
Lanes 0	1	0	0	1	0	0	0	0	0	0	0	0
fW	1.133			1.133			0.967					
fHV	0.980			0.962			0.990					
fG	1.000			1.000			1.000					
fP	1.000			1.000			0.875					
fBB	0.992			1.000			1.000					
fA	1.000			1.000			1.000					
fLU	1.000			1.000			1.000					
fRT	0.941			1.000			0.917					
fLT	1.000			0.409			0.981					
Sec.												
fLpb	1.000			1.000			1.000					
fRpb	1.000			1.000			1.000					
S	1971			848			1431					
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.55	0.50	15.5	1.000	986	0.50	2.0	0.0	17.5	B	17.5	B
Westbound												
LT	1.48	0.50	22.5	1.000	424	0.50	227.8	0.0	250.3	F	250.3	F
Northbound												
LR	0.87	0.39	25.5	1.000	557	0.50	16.6	0.0	42.0	D	42.0	D
Southbound												

Intersection delay = 113.0 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0				
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	351		
Proportion of LT in LT lane group, PLT	0.000	0.560	0.384
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	540		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	8.78		
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50		
gq, (see Exhibit C16-4,5,6,7,8)	12.22		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	32.78		
n=Max(gq-gf)/2,0)	6.11		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.56		
EL1 (refer to Exhibit C16-3)	2.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.41		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.409		

For special case of single-lane approach opposed by multilane approach, see text.

- * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time r=(C-g-gq-gu)

Arrival rate, qa=v/(3600(max[X,1.0]))

Protected ph. departure rate, Sp=s/3600

Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	15.5	0.00	0.0	0.0	17.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	22.5	22.5	0.00	50.8	0.0	250.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.5	0.00	0.0	0.0	42.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			113.0	sec/veh	Intersection LOS F			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup		TR			LT			LR				
Init Queue		0.0			0.0			0.0				
Flow Rate		540			627			487				
So		1900			1900			1900				
No.Lanes	0	1	0	0	1	0	0	0	0	0	0	0
SL		1971			848			1431				
LnCapacity		986			424			557				
Flow Ratio		0.3			0.7			0.3				
v/c Ratio		0.55			1.48			0.87				
Grn Ratio		0.50			0.50			0.39				
I Factor		0.927			0.992			0.953				
AT or PVG		3			3			3				
Pltn Ratio		1.00			1.00			1.00				
PF2		1.00			1.00			1.00				
Q1		9.3			15.7			11.3				
kB		1.0			0.6			0.7				
Q2		1.2			27.2			3.6				
Q Average		10.5			42.8			14.8				
Q Spacing		25.0			25.0			25.0				
Q Storage		0			0			0				
Q S Ratio												
70th Percentile Output:												
fB%		1.2			1.2			1.2				
BOQ		12.8			51.4			17.9				
QSRatio												
85th Percentile Output:												
fB%		1.4			1.4			1.4				
BOQ		15.1			60.0			21.0				
QSRatio												
90th Percentile Output:												
fB%		1.6			1.5			1.5				
BOQ		16.4			64.3			22.6				
QSRatio												
95th Percentile Output:												
fB%		1.7			1.6			1.7				
BOQ		18.1			68.6			24.5				
QSRatio												
98th Percentile Output:												
fB%		1.9			1.7			1.8				
BOQ		19.8			72.8			26.4				
QSRatio												

ERROR MESSAGES

No errors to report.

Alternative 2

Mitigation

Weekday

AM

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume			216	178		158	224	
Peak-Hour Factor, PHF			0.83	0.83		0.83	0.83	
Hourly Flow Rate, HFR			260	214		190	269	
Percent Heavy Vehicles			--	--		11	--	--
Median Type/Storage		Undivided			/			
RT Channelized?				No				
Lanes			1	1		1	1	
Configuration			T	R		L	T	
Upstream Signal?			No				No	
Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		147		146				
Peak Hour Factor, PHF		0.75		0.70				
Hourly Flow Rate, HFR		196		208				
Percent Heavy Vehicles		0		0				
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/			/
Lanes		1		1				
Configuration		L		R				

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config		L	L		R				
v (vph)	190	196			208				
C(m) (vph)	1043	252			784				
v/c	0.18	0.78			0.27				
95% queue length	0.66	5.76			1.07				
Control Delay	9.2	55.9			11.2				
LOS	A	F			B				
Approach Delay				32.9					
Approach LOS				D					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		216	178	158	224	
Peak-Hour Factor, PHF		0.83	0.83	0.83	0.83	
Peak-15 Minute Volume		65	54	48	67	
Hourly Flow Rate, HFR		260	214	190	269	
Percent Heavy Vehicles		--	--	11	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	147		146			
Peak Hour Factor, PHF	0.75		0.70			
Peak-15 Minute Volume	49		52			
Hourly Flow Rate, HFR	196		208			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		11	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		11	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 R_p (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 $g(q_1)$
 $g(q_2)$
 $g(q)$

Computation 2-Proportion of TWSC Intersection Time blocked				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
$p(2)$	0.000
$p(5)$	0.000
$p(dom)$	
$p(subo)$	
Constrained or unconstrained?	

Proportion unblocked for minor movements, $p(x)$	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
$p(1)$			
$p(4)$			
$p(7)$			
$p(8)$			
$p(9)$			
$p(10)$			
$p(11)$			
$p(12)$			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
$V_{c,x}$		474	909		260			
s								
P_x								
$V_{c,u,x}$								
$C_{r,x}$								
$C_{plat,x}$								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	260	
Potential Capacity	784	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	784	
Probability of Queue free St.	0.73	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	474	
Potential Capacity	1043	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1043	
Probability of Queue free St.	0.82	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.82	0.82
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	909	
Potential Capacity	308	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.82
Maj. L, Min T Adj. Imp Factor.		0.86
Cap. Adj. factor due to Impeding mvmnt	0.82	0.63
Movement Capacity	252	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor 1.00 1.00
 Cap. Adj. factor due to Impeding mvmnt 0.82 0.82
 Movement Capacity

Result for 2 stage process:
 a
 y
 C t
 Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows 909
 Potential Capacity 308
 Pedestrian Impedance Factor 1.00 1.00
 Maj. L, Min T Impedance factor 0.82
 Maj. L, Min T Adj. Imp Factor. 0.86
 Cap. Adj. factor due to Impeding mvmnt 0.82 0.63
 Movement Capacity 252

Results for Two-stage process:
 a
 y
 C t 252

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	196		208			
Movement Capacity (vph)	252		784			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	252		784			
Volume	196		208			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		190	196		208			
C(m) (vph)		1043	252		784			
v/c		0.18	0.78		0.27			
95% queue length		0.66	5.76		1.07			
Control Delay		9.2	55.9		11.2			
LOS		A	F		B			
Approach Delay				32.9				
Approach LOS				D				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.82
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		9.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/19/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	3	6	1	284	34	382	0	224	317	123	255	9
Lane Width	15.5			11.0 10.0			12.0 12.0			10.0 11.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right	P		
Green	20.0				19.0	8.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				0.0	2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	560	1679	0.02	0.33	13.5	B	13.5	B
Westbound								
LT	424	1272	0.86	0.33	37.7	D	24.7	C
R	678	1233	0.65	0.55	13.9	B		
Northbound								
LT	533	1684	0.50	0.32	19.5	B	26.6	C
R	461	1455	0.81	0.32	31.6	C		
Southbound								
L	566	1518	0.25	0.50	11.1	B		
TR	814	1627	0.37	0.50	10.5	B	10.7	B

Intersection Delay = 22.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/19/13
Analysis Time Period: Weekday 8-9 AM Peak Period
Intersection: Veterans Rd W & Arthur Kill Rd
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 Miti-Action Alt 2
Project ID: Charleston EIS
E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	284	34	382	0	224	317	123	255	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	82	10	110	0	66	93	35	73	3
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900	1900		1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width	15.5			11.0	10.0		12.0	12.0		10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow	11			365	439		264	373		141	303	
%InSharedLn												
Prop LTS		0.273			0.893			0.000		1.000	0.000	
Prop RTS	0.091			0.000	1.000		0.000	1.000		0.033		
Peds Bikes	0			0	0		0			0		
Buses	0			0	0		4	0		0	3	
%InProtPhase					0.0					0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3			3	3		3	3		3	3	
Unit Ext.	3.0			3.0	3.0		3.0	3.0		3.0	3.0	
I Factor	1.000			0.940			0.887			1.000		
Lost Time	2.0			2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0			2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g	11.5			13.5			15.2			12.1		

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right	P	
Green		20.0							19.0	8.0
Yellow		3.0							3.0	3.0
All Red		2.0							0.0	2.0

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	284	34	382	0	224	317	123	255	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	326	39	439	0	264	373	141	293	10
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	11			365 439			264 373			141 303		
Prop LTs	0.273			0.893			0.000			1.000 0.000		
Prop RTs	0.091			0.000 1.000			0.000 1.000			0.033		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	1	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.990			0.935 0.935			0.901 0.901			0.901 0.901		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.984 1.000			1.000 0.988		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.988			1.000 0.850			1.000 0.850			0.995		
fLT	0.925			0.741			1.000			0.950 1.000		
Sec.										0.525		
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1679			1272 1233			1684 1455			1518 1627		
Sec.										838		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1679	0.01	0.33	560	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	365	1272	0.29	0.33	424	0.86
Right	R	439	1233	# 0.36	0.55	678	0.65
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	264	1684	0.16	0.32	533	0.50
Right	R	373	1455	# 0.26	0.32	461	0.81
Southbound							
Prot		0	1518	0.00	0.217	329	0.00
Perm		141	838	0.17	0.283	237	0.59
Left	L	141			0.50	566	0.25
Prot							
Perm							
Thru	TR	303	1627	0.19	0.50	814	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.61
Total lost time per cycle, L = 3.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.33	13.4	1.000	560	0.50	0.1	0.0	13.5	B	13.5	B	
Westbound													
LT	0.86	0.33	18.7	1.000	424	0.50	19.0	0.0	37.7	D	24.7	C	
R	0.65	0.55	9.4	1.000	678	0.50	4.5	0.0	13.9	B			
Northbound													
LT	0.50	0.32	16.6	1.000	533	0.50	2.9	0.0	19.5	B	26.6	C	
R	0.81	0.32	18.8	1.000	461	0.50	12.8	0.0	31.6	C			
Southbound													
L	0.25	0.50	10.0	1.000	566	0.50	1.1	0.0	11.1	B			
TR	0.37	0.50	9.2	1.000	814	0.50	1.3	0.0	10.5	B	10.7	B	

Intersection delay = 22.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				30.0
Effective permitted green time for LT lane group, g(s)				17.0
Opposing effective green time, go (s)				19.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				141
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				264
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.35
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				4.40
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.68
gq, (see Exhibit C16-4,5,6,7,8)				2.05
gu=g-gq if gq>=gf, or = g-gf if gq<gf				14.95
n=Max(gq-gf)/2,0)				1.02
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.68
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.24
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.52
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.525

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	20.0	20.0	19.0	
Effective permitted green time for LT lane group, g(s)	20.0	20.0	19.0	
Opposing effective green time, go (s)	20.0	20.0	30.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	3	326	0	
Proportion of LT in LT lane group, PLT	0.273	0.893	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.00	
Adjusted opposing flow rate, Vo (veh/h)	365	11	303	
Lost time for LT lane group, tL	5.00	5.00	3.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.43	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.08	0.18	5.05	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	13.0	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67	0.50	
gq, (see Exhibit C16-4,5,6,7,8)	7.73	0.00	3.07	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.96	20.00	15.93	
n=Max(gq-gf)/2,0)	0.00	0.00	1.54	
PTHo=1-PLTo	0.11	0.73	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	
EL1 (refer to Exhibit C16-3)	2.01	1.39	1.89	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.19	0.11	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.92	0.74	0.84	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.925	0.741	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	20.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.73			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.386			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	365			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	20.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	20.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				141
v/c ratio from Capacity Worksheet, X				0.25
Protected phase effective green interval, g (s)				13.0
Opposing queue effective green interval, gq				2.05
Unopposed green interval, gu				14.95
Red time r=(C-g-gq-gu)				30.0
Arrival rate, qa=v/(3600(max[X,1.0]))				0.04
Protected ph. departure rate, Sp=s/3600				0.422
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)				0.26
XPerm				0.47
XProt				
Case				4
Queue at beginning of green arrow, Qa				0.00
Queue at beginning of unsaturated green, Qu				1.26
Residual queue, Qr				0.00
Uniform Delay, d1				10.0

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	20.0	13.4	0.00	0.0	0.0	13.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	20.0	18.7	0.00	0.0	0.0	37.7
R	0.0	0.00	13.5	9.4	0.00	0.0	0.0	13.9
Northbound								
	0.0						0.0	
LT	0.0	0.00	20.5	16.6	0.00	0.0	0.0	19.5
R	0.0	0.00	20.5	18.8	0.00	0.0	0.0	31.6
Southbound								
L	0.0	0.00		10.0	0.00	0.0	0.0	11.1
TR	0.0	0.00	15.0	9.2	0.00	0.0	0.0	10.5
	0.0						0.0	

Intersection Delay	22.0	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	11		365	439	264	373	141	303
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1 0		
SL	1679		1272	1233	1684	1455	1133	1627
LnCapacity	560		424	678	533	461	566	814
Flow Ratio	0.0		0.3	0.4	0.2	0.3	0.1	0.2
v/c Ratio	0.02		0.86	0.65	0.50	0.81	0.25	0.37
Grn Ratio	0.33		0.33	0.55	0.32	0.32	0.50	0.50
I Factor	1.000		0.940		0.887		1.000	
AT or PVG	3		3 3		3 3		3 3	
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1		5.7	5.1	3.6	5.7	1.2	3.1
kB	0.6		0.4	0.6	0.5	0.4	0.6	0.7
Q2	0.0		2.1	1.1	0.5	1.6	0.2	0.4
Q Average	0.1		7.8	6.2	4.0	7.3	1.4	3.5
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.2	1.2	1.3	1.2
BOQ	0.2		9.5	7.6	5.0	9.0	1.8	4.4
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.5	1.5	1.6	1.5
BOQ	0.2		11.4	9.2	6.2	10.8	2.3	5.5
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.7	1.6	1.9	1.7
BOQ	0.3		12.5	10.2	7.0	11.9	2.7	6.2
QSRatio								
95th Percentile Output:								
fB%	2.6		1.8	1.9	2.0	1.8	2.4	2.1
BOQ	0.3		14.1	11.7	8.3	13.4	3.4	7.4
QSRatio								
98th Percentile Output:								
fB%	3.2		2.0	2.1	2.4	2.0	2.8	2.4
BOQ	0.4		15.7	13.2	9.6	15.0	4.1	8.6
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/13
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				62		206	549	74		145	359	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 381 1430 0.76 0.27 33.2 C 33.2 C

Northbound

TR 1033 1823 0.71 0.57 12.6 B 12.6 B

Southbound

L 265 468 0.63 0.57 18.0 B
 T 911 1607 0.45 0.57 9.0 A 11.6 B

Intersection Delay = 15.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				62		206	549	74		145	359	
% Heavy Veh				3		3	11	11		9	9	
PHF				0.93		0.93	0.85	0.85		0.87	0.87	
PK 15 Vol				17		55	161	22		42	103	
Hi Ln Vol												
% Grade					0		0				0	
Ideal Sat					1900		1900			1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					289			733		167	413	
%InSharedLn												
Prop LTs					0.232			0.000		1.000	0.000	
Prop RTs					0.768			0.119			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.980			0.769				0.842	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V					62		206		549	74			145	359	
PHF					0.93		0.93		0.85	0.85			0.87	0.87	
Adj flow					67		222		646	87			167	413	
No. Lanes	0	0	0		0	0	0		0	1	0		1	1	0
Lane group						LR				TR			L	T	
Adj flow						289				733			167	413	
Prop LTs						0.232				0.000			1.000	0.000	
Prop RTs						0.768				0.119				0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG												
So												
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW							1.100			0.933	0.933	
fHV							0.901			0.917	0.917	
fG							1.000			1.000	1.000	
fP							1.000			1.000	1.000	
fBB							0.984			1.000	0.988	
fA							1.000			1.000	1.000	
FLU							1.000			1.000	1.000	
fRT							0.984				1.000	
FLT							1.000			0.288	1.000	
Sec.												
fLpb						1.000	1.000			1.000	1.000	
fRpb						1.000	1.000				1.000	
S						1430	1823			468	1607	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	289	1430	# 0.20	0.27	381	0.76
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	733	1823	# 0.40	0.57	1033	0.71
Right							
Southbound							
Prot							
Perm							
Left	L	167	468	0.36	0.57	265	0.63
Prot							
Perm							
Thru	T	413	1607	0.26	0.57	911	0.45
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.60
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
Westbound													
LR	0.76	0.27	20.2	1.000	381	0.50	13.0	0.0	33.2	C	33.2	C	
Northbound													
TR	0.71	0.57	9.4	1.000	1033	0.50	3.2	0.0	12.6	B	12.6	B	
Southbound													
L	0.63	0.57	8.8	1.000	265	0.50	9.2	0.0	18.0	B			
T	0.45	0.57	7.6	1.000	911	0.50	1.4	0.0	9.0	A	11.6	B	

Intersection delay = 15.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				167
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				733
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				2.78
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				12.22
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				8.71
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.29
n=Max(gq-gf)/2,0)				4.35
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.58
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/h				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.29
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.288

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.232 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				8.71
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.256
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				733
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.768	0.119
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	20.2	0.00	0.0	0.0	33.2
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	9.4	0.00	0.0	0.0	12.6
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	8.8	0.00	0.0	0.0	18.0
T	0.0	0.00	13.0	7.6	0.00	0.0	0.0	9.0
	0.0						0.0	

Intersection Delay	15.9	sec/veh	Intersection LOS	B
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup										L	T	
Init Queue										0.0	0.0	
Flow Rate										167	413	
So										1900	1900	
No.Lanes	0	0	0	0	0	0	0	1	0	1	1	0
SL										468	1607	
LnCapacity										265	911	
Flow Ratio										0.4	0.3	
v/c Ratio										0.63	0.45	
Grn Ratio										0.57	0.57	
I Factor											0.842	
AT or PVG										3	3	
Pltn Ratio										1.00	1.00	
PF2										1.00	1.00	
Q1										1.9	4.0	
kB										0.3	0.7	
Q2										0.5	0.6	
Q Average										2.3	4.6	
Q Spacing										25.0	25.0	
Q Storage										0	0	
Q S Ratio												
70th Percentile Output:												
fB%										1.3	1.2	
BOQ										3.0	5.7	
QSRatio												
85th Percentile Output:												
fB%										1.6	1.5	
BOQ										3.7	6.9	
QSRatio												
90th Percentile Output:												
fB%										1.8	1.7	
BOQ										4.3	7.8	
QSRatio												
95th Percentile Output:												
fB%										2.2	2.0	
BOQ										5.2	9.1	
QSRatio												
98th Percentile Output:												
fB%										2.6	2.3	
BOQ										6.2	10.5	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 FULL Mitigation Alt. 2
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	73	194	169	203	523	79	180	251	74	68	31	41
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	156	468	0.53	0.33	34.1	C		
T	621	1863	0.35	0.33	23.9	C	25.6	C
R	493	1478	0.30	0.33	23.5	C		
Westbound								
L	302	905	0.77	0.33	43.8	D		
TR	1096	3287	0.63	0.33	27.9	C	32.0	C
Northbound								
LT	927	3336	0.50	0.28	29.2	C	28.7	C
R	388	1396	0.21	0.28	26.1	C		
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	350	1574	0.31	0.22	31.4	C	31.1	C

Intersection Delay = 29.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	73	194	169	203	523	79	180	251	74	68	31	41
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	21	55	48	58	150	23	48	67	20	25	12	15
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	83	220	149	233	687			464	80	101	107	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.418			0.000	
Prop RTS		0.000	1.000		0.125			0.000	1.000		0.570	
Peds Bikes	0			0		0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.780			0.979			1.000			0.991	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	73	194	169	203	523	79	180	251	74	68	31	41
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	83	220	149	233	601	86	194	270	80	101	46	61
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	83	220	149	233	687			464	80	101	107	
Prop LTs	1.000	0.000		1.000	0.000			0.418			0.000	
Prop RTs		0.000	1.000		0.125			0.000	1.000		0.570	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.980	0.980	0.980	0.926	0.926		0.926	0.926		0.971	0.971	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.981		1.000	0.850			0.914	
fLT	0.260	1.000		0.551	1.000		0.980			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	468	1863	1478	905	3287		3336	1396		1694	1574	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	83	468	0.18	0.33	156	0.53
Prot							
Perm							
Thru	T	220	1863	0.12	0.33	621	0.35
Right	R	149	1478	0.10	0.33	493	0.30
Westbound							
Prot							
Perm							
Left	L	233	905	# 0.26	0.33	302	0.77
Prot							
Perm							
Thru	TR	687	3287	0.21	0.33	1096	0.63
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	464	3336	# 0.14	0.28	927	0.50
Right	R	80	1396	0.06	0.28	388	0.21
Southbound							
Prot							
Perm							
Left	L	101	1694	0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	107	1574	# 0.07	0.22	350	0.31
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.46
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.56

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.53	0.33	24.3	1.000	156	0.50	9.8	0.0	34.1	C			
T	0.35	0.33	22.7	1.000	621	0.50	1.2	0.0	23.9	C	25.6	C	
R	0.30	0.33	22.2	1.000	493	0.50	1.2	0.0	23.5	C			
Westbound													
L	0.77	0.33	26.9	1.000	302	0.50	16.9	0.0	43.8	D			
TR	0.63	0.33	25.3	1.000	1096	0.50	2.7	0.0	27.9	C	32.0	C	
Northbound													
LT	0.50	0.28	27.3	1.000	927	0.50	1.9	0.0	29.2	C	28.7	C	
R	0.21	0.28	24.9	1.000	388	0.50	1.2	0.0	26.1	C			
Southbound													
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C			
TR	0.31	0.22	29.2	1.000	350	0.50	2.2	0.0	31.4	C	31.1	C	

Intersection delay = 29.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	83	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	687	220		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.08	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.02	5.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	10.04	3.35		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	19.96	26.65		
n=Max(gq-gf)/2,0)	5.02	1.68		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.56	1.61		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.55		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.260	0.551		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.418 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.04			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.335			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	687			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	24.3	0.00	0.0	0.0	34.1
T	0.0	0.00	30.0	22.7	0.00	0.0	0.0	23.9
R	0.0	0.00	30.0	22.2	0.00	0.0	0.0	23.5
Westbound								
L	0.0	0.00	30.0	26.9	0.00	0.0	0.0	43.8
TR	0.0	0.00	30.0	25.3	0.00	0.0	0.0	27.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	32.5	27.3	0.00	0.0	0.0	29.2
R	0.0	0.00	32.5	24.9	0.00	0.0	0.0	26.1
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	29.2	0.00	0.0	0.0	31.4
	0.0						0.0	

Intersection Delay	29.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	TR		LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	83	220	149	233	360		243	80	101	107
So	1900	1900	1900	1900	1900		1900	1900	1900	1900
No.Lanes	1	1	1	1	2	0	2	1	1	0
SL	468	1863	1478	905	1726		1752	1396	1694	1574
LnCapacity	156	621	493	302	575		486	388	376	350
Flow Ratio	0.2	0.1	0.1	0.3	0.2		0.1	0.1	0.1	0.1
v/c Ratio	0.53	0.35	0.30	0.77	0.63		0.50	0.21	0.27	0.31
Grn Ratio	0.33	0.33	0.33	0.33	0.33		0.28	0.28	0.22	0.22
I Factor		0.780			0.979		1.000			0.991
AT or PVG	3	3	3	3	3		3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Q1	1.7	4.2	2.8	5.2	7.6		5.1	1.5	2.1	2.2
kB	0.2	0.6	0.5	0.5	0.8		0.7	0.6	0.6	0.5
Q2	0.3	0.3	0.2	1.4	1.2		0.7	0.2	0.2	0.2
Q Average	1.9	4.5	3.0	6.6	8.8		5.8	1.7	2.3	2.5
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.2	1.3	1.2	1.2		1.2	1.3	1.3	1.3
BOQ	2.5	5.6	3.8	8.1	10.7		7.1	2.1	2.9	3.1
QSRatio										
85th Percentile Output:										
fB%	1.6	1.5	1.6	1.5	1.5		1.5	1.6	1.6	1.6
BOQ	3.1	6.9	4.7	9.8	12.8		8.6	2.7	3.7	3.9
QSRatio										
90th Percentile Output:										
fB%	1.8	1.7	1.8	1.6	1.6		1.7	1.9	1.8	1.8
BOQ	3.6	7.7	5.3	10.8	14.0		9.6	3.1	4.2	4.5
QSRatio										
95th Percentile Output:										
fB%	2.3	2.0	2.1	1.9	1.8		1.9	2.3	2.2	2.2
BOQ	4.4	9.0	6.4	12.4	15.6		11.1	3.9	5.1	5.5
QSRatio										
98th Percentile Output:										
fB%	2.7	2.3	2.5	2.1	2.0		2.2	2.8	2.6	2.6
BOQ	5.3	10.4	7.6	13.9	17.2		12.5	4.7	6.1	6.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR			LTR		DefL	TR		L	TR	
Volume	54	43	227	177	437	6	270	93	51	11	160	102
Lane Width	11.0	12.0			12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	48.0				32.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	303	568	0.20	0.53	12.3	B		
TR	1561	2927	0.20	0.53	11.2	B	11.4	B
Westbound								
LTR	1402	2629	0.51	0.53	14.7	B	14.7	B
Northbound								
DefL	349	981	0.89	0.36	54.1	D		
TR	635	1787	0.26	0.36	21.6	C	42.8	D
Southbound								
L	381	1071	0.04	0.36	19.1	B		
TR	1028	2892	0.34	0.36	22.1	C	22.0	C

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	54	43	227	177	437	6	270	93	51	11	160	102
% Heavy Veh	8	8	8	3	3	3	4	4	4	8	8	8
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
PK 15 Vol	15	12	64	51	126	2	78	27	15	4	53	34
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR			LTR		DefL	TR		L	TR	
Lane Width	11.0	12.0			12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	61	307			712		310	166		14	345	
%InSharedLn												
Prop LTS	1.000	0.000			0.285		1.000	0.000		1.000	0.000	
Prop RTS		0.840			0.010			0.355			0.388	
Peds Bikes	0	0	0	0	0	0	0	0	0	0	0	0
Buses	0	0		0	0		0	0		0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3			3		3	3		3	3	
Unit Ext.	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
I Factor		0.916			0.953			1.000			1.000	
Lost Time	2.0	2.0			2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0			2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		48.0						32.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	54	43	227	177	437	6	270	93	51	11	160	102
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.87	0.87	0.76	0.76	0.76
Adj flow	61	49	258	203	502	7	310	107	59	14	211	134
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR			LTR		DefL	TR		L	TR	
Adj flow	61	307			712		310	166		14	345	
Prop LTs	1.000	0.000			0.285		1.000	0.000		1.000	0.000	
Prop RTs	0.840			0.010			0.355			0.388		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		DefL	TR		L	TR	
So	1900	1900		1900			1900	1900		1900	1900	
Lanes	1	2	0	2	0		0	2	0	1	2	0
fW	0.967	1.000		1.000			1.033	1.033		0.933	0.917	
fHV	0.926	0.926		0.971			0.962	0.962		0.926	0.926	
fG	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fLU	1.000	0.952		0.952			1.000	1.000		1.000	0.952	
fRT		0.874		0.999				0.947			0.942	
fLT	0.334	1.000		0.750			0.520	1.000		0.652	1.000	
Sec.												
fLpb	1.000	1.000		1.000			1.000	1.000		1.000	1.000	
fRpb		1.000		1.000				1.000			1.000	
S	568	2927		2629			981	1787		1071	2892	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	61	568	0.11	0.53	303	0.20
Prot							
Perm							
Thru	TR	307	2927	0.10	0.53	1561	0.20
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	712	2629	# 0.27	0.53	1402	0.51
Right							
Northbound							
Prot							
Perm							
Left	DefL	310	981	# 0.32	0.36	349	0.89
Prot							
Perm							
Thru	TR	166	1787	0.09	0.36	635	0.26
Right							
Southbound							
Prot							
Perm							
Left	L	14	1071	0.01	0.36	381	0.04
Prot							
Perm							
Thru	TR	345	2892	0.12	0.36	1028	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.59
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.20	0.53	11.0	1.000	303	0.50	1.4	0.0	12.3	B		
TR	0.20	0.53	10.9	1.000	1561	0.50	0.3	0.0	11.2	B	11.4	B
Westbound												
LTR	0.51	0.53	13.4	1.000	1402	0.50	1.3	0.0	14.7	B	14.7	B
Northbound												
DefL	0.89	0.36	27.3	1.000	349	0.50	26.8	0.0	54.1	D		
TR	0.26	0.36	20.6	1.000	635	0.50	1.0	0.0	21.6	C	42.8	D
Southbound												
L	0.04	0.36	18.9	1.000	381	0.50	0.2	0.0	19.1	B		
TR	0.34	0.36	21.2	1.000	1028	0.50	0.9	0.0	22.1	C	22.0	C

Intersection delay = 22.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	48.0		32.0	32.0
Effective permitted green time for LT lane group, g(s)	48.0		32.0	32.0
Opposing effective green time, go (s)	48.0		32.0	32.0
Number of lanes in LT lane group, N	1		1	1
Number of lanes in opposing approach, No	2		2	2
Adjusted LT flow rate, VLT (veh/h)	61		310	14
Proportion of LT in LT lane group, PLT	1.000		1.000	1.000
Proportion of LT in opposing flow, PLTo	0.29		0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	712		345	166
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.53		7.75	0.35
Opposing lane util. factor, fLUo	0.952	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.35		4.53	2.08
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.47		0.64	0.64
gq, (see Exhibit C16-4,5,6,7,8)	6.01		1.49	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	41.99		30.51	32.00
n=Max(gq-gf)/2,0)	3.01		0.75	0.00
PTHo=1-PLTo	0.71		1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	1.00
EL1 (refer to Exhibit C16-3)	2.62		1.83	1.53
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.23			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08		0.13	0.13
gdifff=max(gq-gf,0)	6.01		0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.33		0.52	0.65
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.334		0.520	0.652

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		48.0		
Effective permitted green time for LT lane group, g(s)		48.0		
Opposing effective green time, go (s)		48.0		
Number of lanes in LT lane group, N		2		

Number of lanes in opposing approach, No	2
Adjusted LT flow rate, VLT (veh/h)	203
Proportion of LT in LT lane group, PLT	0.000 0.285 0.000 0.000
Proportion of LT in opposing flow, PLTo	0.00
Adjusted opposing flow rate, Vo (veh/h)	307
Lost time for LT lane group, tL	5.00
Computation	
LT volume per cycle, LTC=VLTC/3600	5.08
Opposing lane util. factor, fLUo	0.952 0.952 0.952 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	4.03
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.47
gq, (see Exhibit C16-4,5,6,7,8)	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	48.00
n=Max(gq-gf)/2,0)	0.00
PTHo=1-PLTo	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.75
EL1 (refer to Exhibit C16-3)	1.93
EL2=Max((1-Ptho**n)/Plto, 1.0)	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.07
gdifff=max(gq-gf,0)	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.59
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)	
or flt=[fm+0.91(N-1)]/N**	
Left-turn adjustment, fLT	0.750

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	48.0	48.0		32.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	6.01	0.00		0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.125	0.000		0.000
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	712	307		166
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	0.285		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000

Permitted Right Turns

Effective pedestrian green time, gp (s)	48.0	48.0	32.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0
Vpedg	0	0	0
OCCpedg	0.000	0.000	0.000
Effective green, g (s)	48.0	48.0	32.0
Vbicg	0	0	0

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.840	0.010	0.355
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	21.0	11.0	0.00	0.0	0.0	12.3
TR	0.0	0.00	21.0	10.9	0.00	0.0	0.0	11.2
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	21.0	13.4	0.00	0.0	0.0	14.7
	0.0						0.0	
Northbound								
DefL	0.0	0.00	29.0	27.3	0.00	0.0	0.0	54.1
TR	0.0	0.00	29.0	20.6	0.00	0.0	0.0	21.6
	0.0						0.0	
Southbound								
L	0.0	0.00	29.0	18.9	0.00	0.0	0.0	19.1
TR	0.0	0.00	29.0	21.2	0.00	0.0	0.0	22.1
	0.0						0.0	

Intersection Delay	22.4	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound	Northbound			Southbound		
LaneGroup	L	TR		LTR	DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	
Flow Rate	61	161		373	310	166		14	181	
So	1900	1900		1900	1900	1900		1900	1900	
No.Lanes	1	2	0	2	0	2	0	1	2	0
SL	568	1537		1380	981	1787		1071	1518	
LnCapacity	303	819		736	349	635		381	539	
Flow Ratio	0.1	0.1		0.3	0.3	0.1		0.0	0.1	
v/c Ratio	0.20	0.20		0.51	0.89	0.26		0.04	0.34	
Grn Ratio	0.53	0.53		0.53	0.36	0.36		0.36	0.36	
I Factor		0.916		0.953		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00	1.00		1.00	1.00	
Q1	0.8	2.1		6.0	7.3	2.9		0.2	3.3	
kB	0.5	0.9		0.9	0.5	0.8		0.6	0.7	
Q2	0.1	0.2		0.9	2.8	0.3		0.0	0.4	
Q Average	0.9	2.3		6.8	10.1	3.2		0.3	3.7	
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0	0		0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.3		1.2	1.2	1.3		1.3	1.2	
BOQ	1.2	2.9		8.4	12.2	4.1		0.3	4.6	
QSRatio										
85th Percentile Output:										
fB%	1.7	1.6		1.5	1.4	1.6		1.7	1.5	
BOQ	1.5	3.7		10.1	14.5	5.0		0.4	5.7	
QSRatio										
90th Percentile Output:										
fB%	1.9	1.8		1.6	1.6	1.8		2.0	1.7	
BOQ	1.7	4.2		11.1	15.8	5.7		0.5	6.4	
QSRatio										
95th Percentile Output:										
fB%	2.4	2.2		1.9	1.7	2.1		2.6	2.1	
BOQ	2.2	5.2		12.7	17.5	6.9		0.6	7.7	
QSRatio										
98th Percentile Output:										
fB%	3.0	2.6		2.1	1.9	2.5		3.1	2.4	
BOQ	2.7	6.1		14.3	19.1	8.1		0.8	8.9	
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/29/2013	Jurisd: Staten Island, NY
Period: Weekday 8-9 AM Peak Period	Year : 2020 FULL Mitigation Alt. 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L		TR		LT	R			LTR	L		LT R
Volume	868	259	19	4	284	327	4	16	6	121	5	146
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

		Signal Operations								
Phase	Combination	1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds			
WB	Left		P			SB	Left	P		
	Thru		P				Thru	P		
	Right	P	P				Right	P		
	Peds						Peds			
NB	Right					EB	Right			
SB	Right	P				WB	Right	P		
Green		38.0	21.0					16.0		
Yellow		3.0	3.0					3.0		
All Red		2.0	2.0					2.0		

Intersection Performance Summary								
Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	846	1728	1.13	0.71	86.3	F		
TR	1158	1629	0.26	0.71	5.0	A	66.6	E
Westbound								
LT	428	1835	0.78	0.23	44.9	D	21.2	C
R	1568	1568	0.24	1.00	0.3	A		
Northbound								
LTR	355	1995	0.20	0.18	32.8	C	32.8	C
Southbound								
L	226	1273	0.62	0.18	46.1	D		
LT	320	1801	0.02	0.18	30.6	C	24.5	C
R	969	1478	0.17	0.66	6.4	A		
Intersection Delay = 46.2 (sec/veh) Intersection LOS = D								

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	868	259	19	4	284	327	4	16	6	121	5	146
% Heavy Veh	1	1	1	3	3	3	1	1	1	2	2	2
PHF	0.91	0.91	0.91	0.86	0.86	0.86	0.37	0.37	0.37	0.87	0.87	0.87
PK 15 Vol	238	71	5	1	83	95	3	11	4	35	2	42
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	954	306			335	380		70		139	6	168
%InSharedLn										0		
Prop LTS	1.000	0.000			0.015			0.157		1.000	0.000	
Prop RTS		0.069			0.000	1.000		0.229			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.603			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		38.0	21.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	868	259	19		4	284	327		4	16	6		121	5	146
PHF	0.91	0.91	0.91		0.86	0.86	0.86		0.37	0.37	0.37		0.87	0.87	0.87
Adj flow	954	285	21		5	330	380		11	43	16		139	6	168
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	954	306				335	380			70			139	6	168
Prop LTs	1.000	0.000				0.015				0.157			1.000	0.000	
Prop RTs		0.069				0.000	1.000			0.229				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.990			1.000	0.850			0.969					1.000	0.850
fLT	0.950	1.000			0.994				0.965				0.732	1.000	
Sec.	0.220														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1629			1835	1568			1995				1273	1801	1478
Sec.	400														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		730	1728	# 0.42	0.422	730	1.00
Perm		224	400	# 0.56	0.289	116	1.93
Left	L	954			0.71	846	1.13
Prot							
Perm							
Thru	TR	306	1629	0.19	0.71	1158	0.26
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	335	1835	0.18	0.23	428	0.78
Right	R	380	1568	0.24	1.00	1568	0.24
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	70	1995	0.04	0.18	355	0.20
Right							
Southbound							
Prot							
Perm							
Left	L	139	1273	# 0.11	0.18	226	0.62
Prot							
Perm							
Thru	LT	6	1801	0.00	0.18	320	0.02
Right	R	168	1478	0.11	0.66	969	0.17

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.09
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.23

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.13	0.71	19.2	1.000	846	0.50	67.1	0.0	86.3	F		
TR	0.26	0.71	4.6	1.000	1158	0.50	0.3	0.0	5.0	A	66.6	E
Westbound												
LT	0.78	0.23	32.4	1.000	428	0.50	12.5	0.0	44.9	D	21.2	C
R	0.24	1.00	0.0	0.950	1568	0.50	0.3	0.0	0.3	A		
Northbound												
LTR	0.20	0.18	31.5	1.000	355	0.50	1.2	0.0	32.8	C	32.8	C
Southbound												
L	0.62	0.18	34.2	1.000	226	0.50	11.9	0.0	46.1	D		
LT	0.02	0.18	30.5	1.000	320	0.50	0.1	0.0	30.6	C	24.5	C

R 0.17 0.66 6.0 1.000 969 0.50 0.4 0.0 6.4 A

Intersection delay = 46.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	26.0			16.0
Opposing effective green time, go (s)	21.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	954			139
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.16
Adjusted opposing flow rate, Vo (veh/h)	335			70
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	23.85			3.48
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.38			1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.77			0.82
gq, (see Exhibit C16-4,5,6,7,8)	15.78			1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	10.22			14.85
n=Max(gq-gf)/2,0)	7.89			0.58
PTHo=1-PLTo	0.99			0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.79			1.41
EL2=Max((1-Ptho**n)/Plto, 1.0)	7.50			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.15			0.25
gdifff=max(gq-gf,0)	15.78			1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.22			0.73
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.220			0.732

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		21.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		21.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	5	11	0
Proportion of LT in LT lane group, PLT	0.000	0.015	0.157
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.16
Adjusted opposing flow rate, Vo (veh/h)	306	6	70
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.13	0.28	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.65	0.15	1.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	12.2	6.3	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	1.15
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.78	9.72	14.85
n=Max(gq-gf)/2,0)	0.00	0.00	0.58
PTHo=1-PLTo	1.00	1.00	0.84
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.16	0.00
EL1 (refer to Exhibit C16-3)	1.89	1.38	1.48
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.14	0.13
gdifff=max(gq-gf,0)	0.00	0.00	1.15
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.97	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.994	0.965	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		21.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		306		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.015		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.069
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	954			
v/c ratio from Capacity Worksheet, X	1.13			
Protected phase effective green interval, g (s)	38.0			
Opposing queue effective green interval, gq	15.78			
Unopposed green interval, gu	10.22			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.23			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.28			
XPerm	2.12			
XProt	0.82			
Case	3			
Queue at beginning of green arrow, Qa	9.33			
Queue at beginning of unsaturated green, Qu	3.71			
Residual queue, Qr	3.22			
Uniform Delay, d1	19.2			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		19.2	0.00	27.0	0.0	86.3
TR	0.0	0.00	13.0	4.6	0.00	0.0	0.0	5.0
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	34.5	32.4	0.00	0.0	0.0	44.9
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.3
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	31.5	0.00	0.0	0.0	32.8
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	34.2	0.00	0.0	0.0	46.1
LT	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
R	0.0	0.00	15.5	6.0	0.00	0.0	0.0	6.4

Intersection Delay	46.2	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	954	306		335	380	70		139	6	168
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1188	1629		1835	1568	1995		1273	1801	1478
LnCapacity	846	1158		428	1568	355		226	320	969
Flow Ratio	0.8	0.2		0.2	0.2	0.0		0.1	0.0	0.1
v/c Ratio	1.13	0.26		0.78	0.24	0.20		0.62	0.02	0.17
Grn Ratio	0.71	0.71		0.23	1.00	0.18		0.18	0.18	0.66
I Factor		0.603		0.932		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	11.9	2.7		7.9		1.5		3.2	0.1	1.6
kB	0.6	0.8		0.6	1.5	0.6		0.4	0.5	1.1
Q2	17.6	0.3		1.8	0.5	0.1		0.6	0.0	0.2
Q Average	29.6	3.0		9.7		1.6		3.8	0.1	1.9
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.3		1.2		1.3		1.2	1.3	1.3
BOQ	35.5	3.8		11.8		2.1		4.8	0.2	2.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.6		1.4		1.6		1.5	1.7	1.6
BOQ	41.4	4.7		14.0		2.6		5.9	0.2	3.0
QSRatio										
90th Percentile Output:										
fB%	1.5	1.8		1.6		1.9		1.7	2.0	1.8
BOQ	44.4	5.3		15.2		3.0		6.6	0.3	3.4
QSRatio										
95th Percentile Output:										
fB%	1.6	2.1		1.7		2.3		2.1	2.6	2.3
BOQ	47.4	6.4		16.9		3.8		7.9	0.3	4.3
QSRatio										
98th Percentile Output:										
fB%	1.7	2.5		1.9		2.8		2.4	3.2	2.7
BOQ	50.4	7.6		18.6		4.5		9.2	0.4	5.1
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/31/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	8	20	13	172	16	104	10	202	131	138	311	9
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	631	1456	0.10	0.43	15.4	B	15.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

L	533	1230	0.37	0.43	19.0	B		
T	758	1749	0.02	0.43	14.7	B	18.0	B
R	559	1291	0.21	0.43	16.7	B		

Northbound

LTR	712	1564	0.54	0.46	20.1	C	20.1	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	558	1225	1.08	0.46	64.3	E	64.3	E
-----	-----	------	------	------	------	---	------	---

Intersection Delay = 38.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	20	13	172	16	104	10	202	131	138	311	9
% Heavy Veh	3	3	3	5	5	5	7	7	7	7	7	7
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
PK 15 Vol	3	7	5	49	5	30	3	56	36	45	102	3
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900	1900	1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol			0			0			0			0
Adj Flow	60			195	18	118	381			603		
%InSharedLn												
Prop LTS		0.200		1.000	0.000			0.029			0.302	
Prop RTS	0.317			0.000	1.000		0.383			0.020		
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0	0.0	0.0			0.0		
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000			0.966			0.850			0.090		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5			11.8			18.9			18.3		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		39.0						41.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	20	13	172	16	104	10	202	131	138	311	9
PHF	0.68	0.68	0.68	0.88	0.88	0.88	0.90	0.90	0.90	0.76	0.76	0.76
Adj flow	12	29	19	195	18	118	11	224	146	182	409	12
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	60			195 18 118			381			603		
Prop LTs	0.200			1.000 0.000			0.029			0.302		
Prop RTs	0.317			0.000 1.000			0.383			0.020		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	0	1	0	0	1
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.971		0.952	0.952	0.952	0.935		0.935		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.957		1.000 0.850			0.948		0.997		
fLT	0.967		0.718	1.000		0.981		0.698		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.991		
fRpb	0.982		1.000 1.000			0.979		1.000		
S	1456		1230	1749	1291	1564		1225		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	60	1456	0.04	0.43	631	0.10
Right							
Westbound							
Prot							
Perm							
Left	L	195	1230	# 0.16	0.43	533	0.37
Prot							
Perm							
Thru	T	18	1749	0.01	0.43	758	0.02
Right	R	118	1291	0.09	0.43	559	0.21
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	381	1564	0.24	0.46	712	0.54
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1225	# 0.49	0.46	558	1.08
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.73

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.10	0.43	15.1	1.000	631	0.50	0.3	0.0	15.4	B	15.4	B
Westbound												
L	0.37	0.43	17.2	1.000	533	0.50	1.9	0.0	19.0	B		
T	0.02	0.43	14.6	1.000	758	0.50	0.1	0.0	14.7	B	18.0	B
R	0.21	0.43	15.9	1.000	559	0.50	0.8	0.0	16.7	B		
Northbound												
LTR	0.54	0.46	17.6	1.000	712	0.50	2.4	0.0	20.1	C	20.1	C
Southbound												
LTR	1.08	0.46	24.5	1.000	558	0.50	39.8	0.0	64.3	E	64.3	E

Intersection delay = 38.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		195		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.20		
Adjusted opposing flow rate, Vo (veh/h)		60		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		4.88		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.50		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.80		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.718		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	12	11	182	
Proportion of LT in LT lane group, PLT	0.200	0.000	0.029	0.302
Proportion of LT in opposing flow, PLTo	0.00		0.30	0.03
Adjusted opposing flow rate, Vo (veh/h)	18		603	381
Lost time for LT lane group, tL	5.00		5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.30		0.28	4.55
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.45		15.07	9.52
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.9		23.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57		0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00		15.50	9.45
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.12		18.01	31.55
n=Max(gq-gf)/2,0)	0.00		0.00	4.72
PTHo=1-PLTo	1.00		0.70	0.97
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.20		0.03	0.30
EL1 (refer to Exhibit C16-3)	1.40		2.54	2.04
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00	4.48
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06		0.05	0.06
gdifff=max(gq-gf,0)	0.00		0.00	9.45
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.97		0.98	0.70
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.967		0.981	0.698

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	15.50	9.45
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.378	0.230
OCCpedu	0.000	0.058	0.000	0.048
Opposing flow rate, Vo (veh/h)	18	60	603	381
OCCr	0.000	0.053	0.000	0.028
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.972
Proportion of left turns, PLT	0.200	1.000	0.029	0.302
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.991

Permitted Right Turns

Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.317	1.000	0.383	0.020
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.982	1.000	0.979	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.5	15.1	0.00	0.0	0.0 0.0 0.0	15.4
Westbound								
L	0.0	0.00	25.5	17.2	0.00	0.0	0.0	19.0
T	0.0	0.00	25.5	14.6	0.00	0.0	0.0	14.7
R	0.0	0.00	25.5	15.9	0.00	0.0	0.0	16.7
Northbound								
LTR	0.0 0.0 0.0	0.00	24.5	17.6	0.00	0.0	0.0 0.0 0.0	20.1
Southbound								
LTR	0.0 0.0 0.0	0.00	24.5	24.5	0.00	11.3	0.0 0.0 0.0	64.3

Intersection Delay	38.8	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	60			195	18	118	381			603		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1456			1230	1749	1291	1564			1225		
LnCapacity	631			533	758	559	712			558		
Flow Ratio	0.0			0.2	0.0	0.1	0.2			0.5		
v/c Ratio	0.10			0.37	0.02	0.21	0.54			1.08		
Grn Ratio	0.43			0.43	0.43	0.43	0.46			0.46		
I Factor	1.000			0.966			0.850			0.090		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.9			3.3	0.3	1.8	6.9			15.1		
kB	0.8			0.7	0.9	0.7	0.8			0.1		
Q2	0.1			0.4	0.0	0.2	0.9			6.4		
Q Average	1.0			3.7	0.3	2.0	7.7			21.5		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	1.2			4.6	0.4	2.6	9.4			25.8		
QSRatio												
85th Percentile Output:												
fB%	1.6			1.5	1.7	1.6	1.5			1.4		
BOQ	1.6			5.7	0.5	3.3	11.3			30.2		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.7	2.0	1.8	1.6			1.5		
BOQ	1.9			6.4	0.6	3.7	12.4			32.4		
QSRatio												
95th Percentile Output:												
fB%	2.4			2.1	2.5	2.3	1.8			1.6		
BOQ	2.4			7.7	0.7	4.6	14.0			34.7		
QSRatio												
98th Percentile Output:												
fB%	2.9			2.4	3.1	2.7	2.0			1.7		
BOQ	2.9			8.9	0.9	5.5	15.6			37.0		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/2013
 Period: Weekday 8-9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	175	188		186	217		281		159			
Lane Width	16.0			11.0	11.0			11.0				
RTOR Vol		44						0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left			
Thru	P				Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0					35.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	901	1801	0.39	0.50	15.1	B	15.1	B
----	-----	------	------	------	------	---	------	---

Westbound

L	377	753	0.55	0.50	21.3	C		
T	813	1625	0.30	0.50	14.2	B	17.4	B

Northbound

LR	529	1359	0.88	0.39	42.5	D	42.5	D
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Southbound

Intersection Delay = 26.1 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		175	188	186	217		281		159			
% Heavy Veh		10	10	13	13		9		9			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
PK 15 Vol		48	51	52	61		75		42			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		11.0	11.0			11.0				
RTOR Vol			44						0			
Adj Flow		347		209	244			468				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.639				
Prop RTs		0.452			0.000			0.361				
Peds Bikes		0						0		0		
Buses		5		0	0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.964			0.986			0.858				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		175	188	186	217		281		159			
PHF		0.92	0.92	0.89	0.89		0.94		0.94			
Adj flow		190	157	209	244		299		169			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		347		209	244			468				
Prop LTs		0.000		1.000	0.000			0.639				
Prop RTs		0.452			0.000			0.361				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.967 0.967		0.967			
fHV	0.909		0.885 0.885		0.917			
fG	1.000		1.000 1.000		1.000			
fP	1.000		1.000 1.000		0.875			
fBB	0.980		1.000 1.000		1.000			
fA	1.000		1.000 1.000		1.000			
fLU	1.000		1.000 1.000		1.000			
fRT	0.939		1.000		0.951			
fLT	1.000		0.463 1.000		0.969			
Sec.								
fLpb	1.000		1.000 1.000		1.000			
fRpb	1.000		1.000		1.000			
S	1801		753 1625		1359			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.39	0.50	13.9	1.000	901	0.50	1.2	0.0	15.1	B	15.1	B
Westbound												
L	0.55	0.50	15.6	1.000	377	0.50	5.7	0.0	21.3	C		
T	0.30	0.50	13.2	1.000	813	0.50	0.9	0.0	14.2	B	17.4	B
Northbound												
LR	0.88	0.39	25.6	1.000	529	0.50	16.9	0.0	42.5	D	42.5	D
Southbound												

Intersection delay = 26.1 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		209		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		347		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		5.22		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		8.68		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		7.29		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		37.71		
n=Max(gq-gf)/2,0)		3.65		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.81		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.09		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.46		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.463		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.639
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

Cycle length, C 90.0 sec
 Adj. LT vol from Vol Adjustment Worksheet, v
 v/c ratio from Capacity Worksheet, X
 Protected phase effective green interval, g (s)
 Opposing queue effective green interval, gq
 Unopposed green interval, gu
 Red time $r=(C-g-gq-gu)$
 Arrival rate, $qa=v/(3600(\max[X,1.0]))$
 Protected ph. departure rate, $Sp=s/3600$
 Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$
 XPerm
 XProt
 Case
 Queue at beginning of green arrow, Qa
 Queue at beginning of unsaturated green, Qu
 Residual queue, Qr
 Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	22.5	13.9	0.00	0.0	0.0	15.1
	0.0						0.0	
Westbound								
L	0.0	0.00	22.5	15.6	0.00	0.0	0.0	21.3
T	0.0	0.00	22.5	13.2	0.00	0.0	0.0	14.2
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.6	0.00	0.0	0.0	42.5
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			26.1	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	TR			L	T	LR					
Init Queue	0.0			0.0	0.0	0.0					
Flow Rate	347			209	244	468					
So	1900			1900	1900	1900					
No.Lanes	0	1	0	1	1	0	0	0	0	0	0
SL	1801			753	1625	1359					
LnCapacity	901			377	813	529					
Flow Ratio	0.2			0.3	0.2	0.3					
v/c Ratio	0.39			0.55	0.30	0.88					
Grn Ratio	0.50			0.50	0.50	0.39					
I Factor	0.964			0.986		0.858					
AT or PVG	3			3	3	3					
Pltn Ratio	1.00			1.00	1.00	1.00					
PF2	1.00			1.00	1.00	1.00					
Q1	5.4			3.6	3.6	10.9					
kB	1.0			0.6	1.0	0.6					
Q2	0.6			0.7	0.4	3.3					
Q Average	6.0			4.3	4.0	14.2					
Q Spacing	25.0			25.0	25.0	25.0					
Q Storage	0			0	0	0					
Q S Ratio											
70th Percentile Output:											
fB%	1.2			1.2	1.2	1.2					
BOQ	7.4			5.3	5.0	17.2					
QSRatio											
85th Percentile Output:											
fB%	1.5			1.5	1.5	1.4					
BOQ	9.0			6.6	6.1	20.2					
QSRatio											
90th Percentile Output:											
fB%	1.7			1.7	1.7	1.5					
BOQ	9.9			7.4	6.9	21.8					
QSRatio											
95th Percentile Output:											
fB%	1.9			2.0	2.0	1.7					
BOQ	11.4			8.7	8.2	23.6					
QSRatio											
98th Percentile Output:											
fB%	2.2			2.3	2.4	1.8					
BOQ	12.9			10.0	9.5	25.5					
QSRatio											

ERROR MESSAGES

No errors to report.

Weekday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume			315	29		28	331		
Peak-Hour Factor, PHF			0.85	0.85		0.91	0.91		
Hourly Flow Rate, HFR			370	34		30	363		
Percent Heavy Vehicles			--	--		15	--	--	
Median Type/Storage		Undivided				/			
RT Channelized?			No						
Lanes			1	1		1	1		
Configuration			T	R		L	T		
Upstream Signal?			No				No		
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		54		24					
Peak Hour Factor, PHF		0.94		0.94					
Hourly Flow Rate, HFR		57		25					
Percent Heavy Vehicles		0		0					
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage						/			
Lanes		1		1					
Configuration		L		R					

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound				Eastbound		
Movement	1	4	7	8	9	10	11	12	
Lane Config		L	L		R				
v (vph)	30	57			25				
C(m) (vph)	1088	350			680				
v/c	0.03	0.16			0.04				
95% queue length	0.09	0.57			0.11				
Control Delay	8.4	17.3			10.5				
LOS	A	C			B				
Approach Delay				15.2					
Approach LOS				C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 12-1 MD Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		315	29	28	331	
Peak-Hour Factor, PHF		0.85	0.85	0.91	0.91	
Peak-15 Minute Volume		93	9	8	91	
Hourly Flow Rate, HFR		370	34	30	363	
Percent Heavy Vehicles		--	--	15	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	54		24			
Peak Hour Factor, PHF	0.94		0.94			
Peak-15 Minute Volume	14		6			
Hourly Flow Rate, HFR	57		25			
Percent Heavy Vehicles	0		0			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		15	0		0			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.3	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		15	0		0			
t(f)		2.3	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)

alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p

	0.000	0.000
--	-------	-------

Computation 3-Platoon Event Periods Result

p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Stage I	(3) Process Stage II
---	--------------------------------	-----------------------------	----------------------------

p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	--------	--------	---------	---------	---------

V c,x		404	793		370			
s								
Px								
V c,u,x								

C r,x
C plat,x

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	370	
Potential Capacity	680	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	680	
Probability of Queue free St.	0.96	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	404	
Potential Capacity	1088	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1088	
Probability of Queue free St.	0.97	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	793	
Potential Capacity	360	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.97	0.94
Movement Capacity	350	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor 1.00 1.00
 Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
 Movement Capacity

Result for 2 stage process:
 a
 y
 C t
 Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows 793
 Potential Capacity 360
 Pedestrian Impedance Factor 1.00 1.00
 Maj. L, Min T Impedance factor 0.97
 Maj. L, Min T Adj. Imp Factor. 0.98
 Cap. Adj. factor due to Impeding mvmnt 0.97 0.94
 Movement Capacity 350

Results for Two-stage process:
 a
 y
 C t 350

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	57		25			
Movement Capacity (vph)	350		680			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	350		680			
Volume	57		25			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		30	57		25			
C(m) (vph)		1088	350		680			
v/c		0.03	0.16		0.04			
95% queue length		0.09	0.57		0.11			
Control Delay		8.4	17.3		10.5			
LOS		A	C		B			
Approach Delay				15.2				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.97
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.4
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/19/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	1	17	6	299	24	496	1	160	300	249	199	1
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		28.0					22.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	799	1712	0.04	0.47	8.8	A	8.8	A
Westbound								
LT	583	1250	0.62	0.47	16.3	B	30.5	C
R	581	1244	0.95	0.47	39.9	D		
Northbound								
LT	619	1689	0.28	0.37	14.5	B	18.3	B
R	534	1455	0.61	0.37	20.3	C		
Southbound								
L	393	1072	0.74	0.37	28.2	C		
TR	619	1688	0.37	0.37	15.7	B	22.7	C

Intersection Delay = 25.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/19/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	299	24	496	1	160	300	249	199	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	83	7	138	1	43	82	72	58	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900		1900	1900
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		28			359	551		175	326	290	232	
%InSharedLn												
Prop LTs		0.036			0.925			0.006		1.000	0.000	
Prop RTs		0.250			0.000	1.000		0.000	1.000		0.004	
Peds Bikes	0			0	0		0			0		0
Buses		0			0	0		3	0	0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		28.0							22.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	299	24	496	1	160	300	249	199	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	332	27	551	1	174	326	290	231	1
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	28			359 551			175 326			290 232		
Prop LTs	0.036			0.925			0.006			1.000 0.000		
Prop RTs	0.250			0.000 1.000			0.000 1.000			0.004		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.962			0.943 0.943			0.901 0.901			0.935 0.935		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988 1.000			1.000 0.984		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.966			1.000 0.850			1.000 0.850			0.999		
fLT	0.992			0.722			0.999			0.647 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1712			1250 1244			1689 1455			1072 1688		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1712	0.02	0.47	799	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	359	1250	0.29	0.47	583	0.62
Right	R	551	1244	# 0.44	0.47	581	0.95
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	175	1689	0.10	0.37	619	0.28
Right	R	326	1455	0.22	0.37	534	0.61
Southbound							
Prot							
Perm							
Left	L	290	1072	# 0.27	0.37	393	0.74
Prot							
Perm							
Thru	TR	232	1688	0.14	0.37	619	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.04	0.47	8.7	1.000	799	0.50	0.1	0.0	8.8	A	8.8	A
Westbound												
LT	0.62	0.47	12.0	1.000	583	0.50	4.3	0.0	16.3	B	30.5	C
R	0.95	0.47	15.3	1.000	581	0.50	24.5	0.0	39.9	D		
Northbound												
LT	0.28	0.37	13.4	1.000	619	0.50	1.1	0.0	14.5	B	18.3	B
R	0.61	0.37	15.5	1.000	534	0.50	4.8	0.0	20.3	C		
Southbound												
L	0.74	0.37	16.5	1.000	393	0.50	11.7	0.0	28.2	C		
TR	0.37	0.37	14.0	1.000	619	0.50	1.7	0.0	15.7	B	22.7	C

Intersection delay = 25.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				22.0
Effective permitted green time for LT lane group, g(s)				22.0
Opposing effective green time, go (s)				22.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				290
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				175
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/3600				4.83
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				2.92
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.63
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				22.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.55
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.18
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.65
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.647

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	28.0	28.0	22.0	
Effective permitted green time for LT lane group, g(s)	28.0	28.0	22.0	
Opposing effective green time, go (s)	28.0	28.0	22.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	332	1	
Proportion of LT in LT lane group, PLT	0.036	0.925	0.006	0.000
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.00	
Adjusted opposing flow rate, Vo (veh/h)	359	28	232	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.53	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.98	0.47	3.87	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	21.7	0.0	16.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.53	0.53	0.63	
gq, (see Exhibit C16-4,5,6,7,8)	4.92	0.00	0.62	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.28	28.00	6.01	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.08	0.96	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.01	
EL1 (refer to Exhibit C16-3)	2.00	1.42	1.76	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.14	0.09	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.722	0.999	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	28.0		22.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	4.92		0.62	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.176		0.028	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	359		232	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.006	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	28.0		22.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	28.0		22.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	16.0	8.7	0.00	0.0	0.0	8.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	16.0	12.0	0.00	0.0	0.0	16.3
R	0.0	0.00	16.0	15.3	0.00	0.0	0.0	39.9
Northbound								
	0.0						0.0	
LT	0.0	0.00	19.0	13.4	0.00	0.0	0.0	14.5
R	0.0	0.00	19.0	15.5	0.00	0.0	0.0	20.3
Southbound								
L	0.0	0.00	19.0	16.5	0.00	0.0	0.0	28.2
TR	0.0	0.00	19.0	14.0	0.00	0.0	0.0	15.7
	0.0						0.0	

Intersection Delay	25.0	sec/veh	Intersection LOS	C
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	28		359	551	175	326	290	232
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	0	
SL	1712		1250	1244	1689	1455	1072	1688
LnCapacity	799		583	581	619	534	393	619
Flow Ratio	0.0		0.3	0.4	0.1	0.2	0.3	0.1
v/c Ratio	0.04		0.62	0.95	0.28	0.61	0.74	0.37
Grn Ratio	0.47		0.47	0.47	0.37	0.37	0.37	0.37
I Factor	1.000		0.887		0.931		1.000	
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.3		4.5	8.8	2.1	4.4	4.2	2.8
kB	0.7		0.5	0.5	0.6	0.5	0.4	0.6
Q2	0.0		0.8	4.4	0.2	0.8	1.2	0.4
Q Average	0.3		5.3	13.2	2.3	5.2	5.4	3.2
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.3
BOQ	0.4		6.5	15.9	2.9	6.4	6.6	4.0
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.4	1.6	1.5	1.5	1.6
BOQ	0.5		8.0	18.7	3.6	7.9	8.0	5.0
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.5	1.8	1.7	1.7	1.8
BOQ	0.6		8.9	20.3	4.2	8.7	8.9	5.7
QSRatio								
95th Percentile Output:								
fB%	2.5		1.9	1.7	2.2	2.0	1.9	2.1
BOQ	0.7		10.3	22.0	5.1	10.2	10.4	6.8
QSRatio								
98th Percentile Output:								
fB%	3.1		2.2	1.8	2.6	2.2	2.2	2.5
BOQ	0.9		11.8	23.8	6.1	11.6	11.9	8.0
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/22/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				101		207	478	79		194	471	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		16.0					34.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 385 1444 0.92 0.27 49.7 D 49.7 D

Northbound

TR 1059 1868 0.57 0.57 10.3 B 10.3 B

Southbound

L 329 581 0.69 0.57 15.0 B
 T 933 1646 0.59 0.57 9.8 A 11.3 B

Intersection Delay = 18.8 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				101		207	478	79		194	471	
% Heavy Veh				3		3	8	8		6	6	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
PK 15 Vol				29		59	130	21		56	137	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					354			606		226	548	
%InSharedLn												
Prop LTs					0.328			0.000		1.000	0.000	
Prop RTs					0.672			0.142			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.944			0.880				0.500	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		16.0							34.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				101		207	478	79		194	471	
PHF				0.87		0.87	0.92	0.92		0.86	0.86	
Adj flow				116		238	520	86		226	548	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group				LR			TR			L T		
Adj flow					354			606		226	548	
Prop LTs					0.328			0.000		1.000	0.000	
Prop RTs					0.672			0.142			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG												
So												
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW							1.100			0.933	0.933	
fHV							0.926			0.943	0.943	
fG							1.000			1.000	1.000	
fP							1.000			1.000	1.000	
fBB							0.984			1.000	0.984	
fA							1.000			1.000	1.000	
FLU							1.000			1.000	1.000	
fRT							0.981				1.000	
fLT							1.000			0.348	1.000	
Sec.												
fLpb					1.000		1.000			1.000	1.000	
fRpb					1.000		1.000				1.000	
S					1444		1868			581	1646	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	354	1444	# 0.25	0.27	385	0.92
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	606	1868	0.32	0.57	1059	0.57
Right							
Southbound							
Prot							
Perm							
Left	L	226	581	# 0.39	0.57	329	0.69
Prot							
Perm							
Thru	T	548	1646	0.33	0.57	933	0.59
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.92	0.27	21.4	1.000	385	0.50	28.3	0.0	49.7	D	49.7	D
Northbound												
TR	0.57	0.57	8.3	1.000	1059	0.50	2.0	0.0	10.3	B	10.3	B
Southbound												
L	0.69	0.57	9.2	1.000	329	0.50	5.8	0.0	15.0	B		
T	0.59	0.57	8.4	1.000	933	0.50	1.4	0.0	9.8	A	11.3	B

Intersection delay = 18.8 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				34.0
Effective permitted green time for LT lane group, g(s)				34.0
Opposing effective green time, go (s)				34.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				226
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				606
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				3.77
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				10.10
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.43
gq, (see Exhibit C16-4,5,6,7,8)				6.86
gu=g-gq if gq>=gf, or = g-gf if gq<gf				27.14
n=Max(gq-gf)/2,0)				3.43
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.12
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.35
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.348

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.328 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				34.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				6.86
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.202
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				606
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		34.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		34.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.672	0.142
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	22.0	21.4	0.00	0.0	0.0	49.7
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.0	8.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Southbound								
L	0.0	0.00	13.0	9.2	0.00	0.0	0.0	15.0
T	0.0	0.00	13.0	8.4	0.00	0.0	0.0	9.8
	0.0						0.0	

Intersection Delay	18.8	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup					LR		TR	L	T
Init Queue					0.0		0.0	0.0	0.0
Flow Rate					354		606	226	548
So					1900		1900	1900	1900
No.Lanes	0	0	0	0	0	0	1	1	0
SL					1444		1868	581	1646
LnCapacity					385		1059	329	933
Flow Ratio					0.2		0.3	0.4	0.3
v/c Ratio					0.92		0.57	0.69	0.59
Grn Ratio					0.27		0.57	0.57	0.57
I Factor					0.944		0.880		0.500
AT or PVG					3		3	3	3
Pltn Ratio					1.00		1.00	1.00	1.00
PF2					1.00		1.00	1.00	1.00
Q1					5.7		6.5	2.7	5.9
kB					0.4		0.8	0.2	0.4
Q2					2.8		1.0	0.4	0.6
Q Average					8.5		7.5	3.1	6.5
Q Spacing					25.0		25.0	25.0	25.0
Q Storage					0		0	0	0
Q S Ratio									
70th Percentile Output:									
fB%					1.2		1.2	1.3	1.2
BOQ					10.4		9.2	3.9	8.0
QSRatio									
85th Percentile Output:									
fB%					1.5		1.5	1.6	1.5
BOQ					12.4		11.0	4.8	9.6
QSRatio									
90th Percentile Output:									
fB%					1.6		1.6	1.8	1.6
BOQ					13.5		12.1	5.5	10.6
QSRatio									
95th Percentile Output:									
fB%					1.8		1.8	2.1	1.9
BOQ					15.2		13.7	6.6	12.2
QSRatio									
98th Percentile Output:									
fB%					2.0		2.0	2.5	2.1
BOQ					16.8		15.3	7.8	13.7
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	149	349	152	215	693	84	163	326	223	149	67	89
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P	P			SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right		P			EB Right			
SB Right					WB Right			
Green	26.0	6.0			20.0	20.0		
Yellow	3.0	3.0			3.0	3.0		
All Red	0.0	2.0			2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	292	1728	0.61	0.39	41.6	D		
T	543	1881	0.76	0.29	37.7	D	36.5	D
R	431	1492	0.33	0.29	26.9	C		
Westbound								
L	289	1589	0.83	0.39	56.2	E		
TR	972	3365	0.87	0.29	40.5	D	43.9	D
Northbound								
LT	773	3479	0.68	0.22	36.9	D	33.6	C
R	499	1449	0.48	0.34	26.5	C		
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	353	1590	0.55	0.22	37.1	D	36.0	D

Intersection Delay = 38.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	149	349	152	215	693	84	163	326	223	149	67	89
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	44	104	45	60	193	23	44	88	60	47	21	28
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	177	415	143	239	849			526	240	186	195	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.333			0.000	
Prop RTS		0.000	1.000		0.093			0.000	1.000		0.569	
Peds Bikes	0			0		0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase	0.0			0.0								
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.856			0.927			1.000			0.985	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P	P			SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right		P			EB	Right		
SB	Right					WB	Right		
Green		26.0	6.0				20.0	20.0	
Yellow		3.0	3.0				3.0	3.0	
All Red		0.0	2.0				2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	149	349	152	215	693	84	163	326	223	149	67	89
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	177	415	143	239	770	79	175	351	240	186	84	111
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	177	415	143	239	849			526	240	186	195	
Prop LTs	1.000	0.000		1.000	0.000			0.333			0.000	
Prop RTs		0.000	1.000		0.093			0.000	1.000		0.569	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.943	0.943		0.962	0.962		0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.986		1.000	0.850			0.915	
fLT	0.950	1.000		0.950	1.000		0.984			0.950	1.000	
Sec.	0.167			0.213								
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	1728	1881	1492	1589	3365		3479	1449		1711	1590	
Sec.	303			356								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		96	1728	0.06	0.122	211	0.45
Perm		81	303	# 0.27	0.267	81	1.00
Left	L	177			0.39	292	0.61
Prot							
Perm							
Thru	T	415	1881	0.22	0.29	543	0.76
Right	R	143	1492	0.10	0.29	431	0.33
Westbound							
Prot		144	1589	# 0.09	0.122	194	0.74
Perm		95	356	0.27	0.267	95	1.00
Left	L	239			0.39	289	0.83
Prot							
Perm							
Thru	TR	849	3365	0.25	0.29	972	0.87
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	526	3479	# 0.15	0.22	773	0.68
Right	R	240	1449	0.17	0.34	499	0.48
Southbound							
Prot							
Perm							
Left	L	186	1711	0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	195	1590	# 0.12	0.22	353	0.55
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.61	0.39	33.8	1.000	292	0.50	7.8	0.0	41.6	D			
T	0.76	0.29	29.2	1.000	543	0.50	8.5	0.0	37.7	D	36.5	D	
R	0.33	0.29	25.2	1.000	431	0.50	1.8	0.0	26.9	C			
Westbound													
L	0.83	0.39	34.6	1.000	289	0.50	21.6	0.0	56.2	E			
TR	0.87	0.29	30.4	1.000	972	0.50	10.1	0.0	40.5	D	43.9	D	
Northbound													
LT	0.68	0.22	32.1	1.000	773	0.50	4.8	0.0	36.9	D	33.6	C	
R	0.48	0.34	23.2	1.000	499	0.50	3.3	0.0	26.5	C			
Southbound													
L	0.49	0.22	30.5	1.000	380	0.50	4.4	0.0	34.9	C			
TR	0.55	0.22	31.0	1.000	353	0.50	6.0	0.0	37.1	D	36.0	D	

Intersection delay = 38.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0		
Effective permitted green time for LT lane group, g(s)	24.0	24.0		
Opposing effective green time, go (s)	26.0	26.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	177	239		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	849	415		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.43	5.98		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.15	10.38		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.71	0.71		
gq, (see Exhibit C16-4,5,6,7,8)	16.08	14.18		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.92	9.82		
n=Max(gq-gf)/2,0)	8.04	7.09		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	3.00	1.93		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.17		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.21		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.167	0.213		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.333 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	26.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	16.08			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.618			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	849			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		26.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		26.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.093
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	177	239		
v/c ratio from Capacity Worksheet, X	0.61	0.83		
Protected phase effective green interval, g (s)	11.0	11.0		
Opposing queue effective green interval, gq	16.08	14.18		
Unopposed green interval, gu	7.92	9.82		
Red time r=(C-g-gq-gu)	55.0	55.0		
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.07		
Protected ph. departure rate, Sp=s/3600	0.480	0.441		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.25	0.24		
XPerm	1.92	2.21		
XProt				
Case	5	5		
Queue at beginning of green arrow, Qa	1.86	2.87		
Queue at beginning of unsaturated green, Qu	3.49	4.59		
Residual queue, Qr	0.00	0.00		
Uniform Delay, d1	33.8	34.6		

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		33.8	0.00	0.0	0.0	41.6
T	0.0	0.00	32.0	29.2	0.00	0.0	0.0	37.7
R	0.0	0.00	32.0	25.2	0.00	0.0	0.0	26.9
Westbound								
L	0.0	0.00		34.6	0.00	0.0	0.0	56.2
TR	0.0	0.00	32.0	30.4	0.00	0.0	0.0	40.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	35.0	32.1	0.00	0.0	0.0	36.9
R	0.0	0.00	29.5	23.2	0.00	0.0	0.0	26.5
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	31.0	0.00	0.0	0.0	37.1
	0.0						0.0	

Intersection Delay	38.4	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	L	T	R	L	TR	LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	177	415	143	239	445	276	240	186	195
So	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	2	2	1	1	0
SL	751	1881	1492	744	1767	1827	1449	1711	1590
LnCapacity	292	543	431	289	510	405	499	380	353
Flow Ratio	0.2	0.2	0.1	0.3	0.3	0.2	0.2	0.1	0.1
v/c Ratio	0.61	0.76	0.33	0.83	0.87	0.68	0.48	0.49	0.55
Grn Ratio	0.39	0.29	0.29	0.39	0.29	0.22	0.34	0.22	0.22
I Factor		0.856			0.927	1.000			0.985
AT or PVG	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.9	9.5	2.8	4.1	10.6	6.3	4.7	4.1	4.3
kB	0.4	0.6	0.5	0.4	0.7	0.6	0.7	0.6	0.5
Q2	0.6	1.9	0.3	1.7	3.2	1.2	0.6	0.5	0.6
Q Average	3.5	11.3	3.1	5.7	13.8	7.5	5.4	4.6	5.0
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2
BOQ	4.4	13.7	3.9	7.1	16.7	9.2	6.6	5.7	6.1
QSRatio									
85th Percentile Output:									
fB%	1.5	1.4	1.6	1.5	1.4	1.5	1.5	1.5	1.5
BOQ	5.5	16.2	4.8	8.6	19.6	11.0	8.0	7.0	7.5
QSRatio									
90th Percentile Output:									
fB%	1.7	1.6	1.8	1.7	1.5	1.6	1.7	1.7	1.7
BOQ	6.2	17.6	5.5	9.5	21.2	12.1	8.9	7.8	8.4
QSRatio									
95th Percentile Output:									
fB%	2.1	1.7	2.1	1.9	1.7	1.8	1.9	2.0	2.0
BOQ	7.4	19.3	6.6	11.0	23.0	13.7	10.4	9.2	9.8
QSRatio									
98th Percentile Output:									
fB%	2.4	1.9	2.5	2.2	1.8	2.0	2.2	2.3	2.3
BOQ	8.6	21.0	7.7	12.5	24.8	15.3	11.9	10.6	11.2
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/22/13

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 Miti-Action Alt 2

N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	62	156	476	225	475	18	296	200	88	23	527	225
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P	P			SB Left	P	P	
Thru	P	P			Thru	P	P	
Right	P	P			Right	P	P	
Peds		X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	24.0	10.0			14.0	14.0	9.0	
Yellow	3.0	3.0			3.0	3.0	3.0	
All Red	0.0	2.0			0.0	0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	161	603	0.46	0.27	35.8	D		
TR	839	3146	0.90	0.27	44.8	D	44.0	D
Westbound								
DefL	374	1752	0.67	0.41	40.3	D		
TR	754	1835	0.73	0.41	27.9	C	31.8	C
Northbound								
DefL	368	1811	0.92	0.29	65.3	E		
TR	525	1819	0.63	0.29	33.5	C	49.6	D
Southbound								
L	338	1504	0.08	0.34	20.4	C		
TR	974	2828	0.86	0.34	37.2	D	36.7	D

Intersection Delay = 40.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	62	156	476	225	475	18	296	200	88	23	527	225
% Heavy Veh	2	2	2	3	3	3	3	3	3	12	12	12
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
PK 15 Vol	18	46	142	63	132	5	85	57	25	6	146	63
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	74	753		250	548		340	331		26	836	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.753			0.036			0.305			0.299	
Peds Bikes	0	0		0	0		0	0		0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0	0.0		0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.889			0.932			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds	X	X
WB	Left	P	P				SB	Left	P	P
	Thru	P	P					Thru	P	P
	Right	P	P					Right	P	P
	Peds		X					Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		24.0	10.0					14.0	14.0	9.0
Yellow		3.0	3.0					3.0	3.0	3.0
All Red		0.0	2.0					0.0	0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	62	156	476	225	475	18	296	200	88	23	527	225
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.87	0.87	0.87	0.90	0.90	0.90
Adj flow	74	186	567	250	528	20	340	230	101	26	586	250
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	74	753		250	548		340	331		26	836	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.753			0.036			0.305			0.299	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.967	1.000		1.000	1.000		1.033	1.033		0.933	0.917	
fHV	0.980	0.980		0.971	0.971		0.971	0.971		0.893	0.893	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.887			0.995			0.954			0.955	
fLT	0.335	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.				0.182			0.338			0.347		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	603	3146		1752	1835		1811	1819		1504	2828	
Sec.				335			644			550		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	74	603	0.12	0.27	161	0.46
Prot							
Perm							
Thru	TR	753	3146	0.24	0.27	839	0.90
Right							
Westbound							
Prot		168	1752	0.10	0.167	292	0.58
Perm		82	335	0.24	0.244	82	1.00
Left	DefL	250			0.41	374	0.67
Prot							
Perm				#			
Thru	TR	548	1835	# 0.30	0.41	754	0.73
Right							
Northbound							
Prot		254	1811	0.14	0.156	282	0.90
Perm		86	644	0.13	0.133	86	1.00
Left	DefL	340			0.29	368	0.92
Prot							
Perm							
Thru	TR	331	1819	# 0.18	0.29	525	0.63
Right							
Southbound							
Prot		26	1504	0.02	0.156	234	0.11
Perm		0	550	0.00	0.189	104	0.00
Left	L	26			0.34	338	0.08
Prot							
Perm							
Thru	TR	836	2828	# 0.30	0.34	974	0.86
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.02
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.46	0.27	27.6	1.000	161	0.50	8.2	0.0	35.8	D			
TR	0.90	0.27	31.8	1.000	839	0.50	13.0	0.0	44.8	D	44.0	D	
Westbound													
DefL	0.67	0.41	31.8	1.000	374	0.50	8.6	0.0	40.3	D			
TR	0.73	0.41	22.3	1.000	754	0.50	5.7	0.0	27.9	C	31.8	C	
Northbound													
DefL	0.92	0.29	34.2	1.000	368	0.50	31.1	0.0	65.3	E			
TR	0.63	0.29	27.8	1.000	525	0.50	5.7	0.0	33.5	C	49.6	D	
Southbound													
L	0.08	0.34	19.9	1.000	338	0.50	0.4	0.0	20.4	C			
TR	0.86	0.34	27.5	1.000	974	0.50	9.7	0.0	37.2	D	36.7	D	

Intersection delay = 40.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	24.0	37.0	26.0	31.0
Effective permitted green time for LT lane group, g(s)	24.0	22.0	12.0	17.0
Opposing effective green time, go (s)	37.0	24.0	31.0	26.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	74	250	340	26
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	548	753	836	331
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00

Computation

LT volume per cycle, LTC=VLT/C	1.85	6.25	8.50	0.65
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	6.85	9.89	10.98	4.14
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.59	0.73	0.66	0.71
gq, (see Exhibit C16-4,5,6,7,8)	6.52	13.58	0.00	6.48
gu=g-gq if gq>=gf, or = g-gf if gq<gf	17.48	8.42	12.00	10.52
n=Max(gq-gf)/2,0)	3.26	6.79	0.00	3.24
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.18	2.73	2.96	1.78
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.18	0.33	0.24
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.33	0.18	0.34	0.35
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.335	0.182	0.338	0.347

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdif = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdif / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		24.0		14.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Pedestrian flow rate, Vpedg (p/h)		0		0
OCCpedg		0.000		0.000
Opposing queue clearing green, gq (s)		13.58		6.48
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.566		0.463
OCCpedu		0.000		0.000
Opposing flow rate, Vo (veh/h)		753		331
OCCr		0.000		0.000
Number of cross-street receiving lanes, Nrec		2		2
Number of turning lanes, Nturn		1		1
ApbT		1.000		1.000
Proportion of left turns, PLT		1.000		1.000
Proportion of left turns using protected phase, PLTA		0.000		0.000
Left-turn adjustment, fLpb		1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	24.0	10.0	26.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	24.0	22.0	26.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.753	0.036	0.305
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	250	340	26	
v/c ratio from Capacity Worksheet, X	0.67	0.92	0.08	
Protected phase effective green interval, g (s)	15.0	14.0	14.0	
Opposing queue effective green interval, gq	13.58	0.00	6.48	
Unopposed green interval, gu	8.42	12.00	10.52	
Red time r=(C-g-gq-gu)	53.0	64.0	59.0	
Arrival rate, qa=v/(3600(max[X,1.0]))	0.07	0.09	0.01	
Protected ph. departure rate, Sp=s/3600	0.487	0.503	0.418	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.24	0.18	0.25	
XPerm	2.54	3.34	0.05	
XProt			0.09	
Case	5	5	1	
Queue at beginning of green arrow, Qa	3.16	5.03	0.43	
Queue at beginning of unsaturated green, Qu	4.62	6.04	0.05	
Residual queue, Qr	0.00	0.00	0.00	
Uniform Delay, d1	31.8	34.2	19.9	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	33.0	27.6	0.00	0.0	0.0	35.8
TR	0.0	0.00	33.0	31.8	0.00	0.0	0.0	44.8
	0.0						0.0	
Westbound								
DefL	0.0	0.00		31.8	0.00	0.0	0.0	40.3
TR	0.0	0.00	26.5	22.3	0.00	0.0	0.0	27.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00		34.2	0.00	0.0	0.0	65.3
TR	0.0	0.00	32.0	27.8	0.00	0.0	0.0	33.5
	0.0						0.0	
Southbound								
L	0.0	0.00		19.9	0.00	0.0	0.0	20.4
TR	0.0	0.00	29.5	27.5	0.00	0.0	0.0	37.2
	0.0						0.0	

Intersection Delay	40.1	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	74	395		250	548		340	331		26	439	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	603	1652		909	1835		1272	1819		981	1485	
LnCapacity	161	440		374	754		368	525		338	511	
Flow Ratio	0.1	0.2		0.3	0.3		0.3	0.2		0.0	0.3	
v/c Ratio	0.46	0.90		0.67	0.73		0.92	0.63		0.08	0.86	
Grn Ratio	0.27	0.27		0.41	0.41		0.29	0.29		0.34	0.34	
I Factor		0.889			0.932			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	1.5	9.5		4.1	11.5		7.1	7.2		0.4	10.2	
kB	0.3	0.6		0.5	0.9		0.6	0.7		0.5	0.7	
Q2	0.2	3.2		1.0	2.1		3.5	1.2		0.0	3.2	
Q Average	1.8	12.7		5.2	13.7		10.5	8.4		0.5	13.4	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	2.3	15.4		6.4	16.5		12.8	10.2		0.6	16.2	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.5	1.4		1.4	1.5		1.7	1.4	
BOQ	2.9	18.1		7.8	19.4		15.1	12.2		0.8	19.1	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5		1.7	1.5		1.6	1.6		2.0	1.5	
BOQ	3.3	19.6		8.6	20.9		16.4	13.4		0.9	20.6	
QSRatio												
95th Percentile Output:												
fB%	2.3	1.7		2.0	1.7		1.7	1.8		2.5	1.7	
BOQ	4.1	21.4		10.1	22.7		18.1	15.0		1.2	22.4	
QSRatio												
98th Percentile Output:												
fB%	2.8	1.8		2.2	1.8		1.9	2.0		3.1	1.8	
BOQ	4.9	23.1		11.5	24.5		19.8	16.6		1.5	24.2	
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 6 < minimum green time for peds.
WARNING: Phase 7 < minimum green time for peds.

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	684	430	3	1	449	796	0	0	1	125	0	136
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		36.0	23.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

L	764	1711	0.98	0.71	45.7	D		
TR	1158	1628	0.41	0.71	6.1	A	30.4	C

LT	471	1843	1.03	0.26	71.4	E	25.9	C
R	1568	1568	0.56	1.00	0.8	A		

LTR	328	1844	0.01	0.18	30.6	C	30.6	C
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L	233	1313	0.55	0.18	42.9	D			
LT	320	1801	0.00	0.18	30.4	C	24.2	C	
R	936	1478	0.15	0.63	7.0	A			

Intersection Delay = 27.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	684	430	3	1	449	796	0	0	1	125	0	136
% Heavy Veh	2	2	2	3	3	3	0	0	1	2	2	2
PHF	0.91	0.91	0.91	0.91	0.93	0.91	0.25	0.25	0.25	0.97	0.97	0.97
PK 15 Vol	188	118	1	1	121	219	0	0	1	32	0	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	752	476			484	875		4		129	0	140
%InSharedLn										0		
Prop LTS	1.000	0.000			0.002			0.000		1.000	0.000	
Prop RTS		0.006			0.000	1.000		1.000			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.735			0.546			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6			24.6			20.9			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		36.0	23.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	684	430	3		1	449	796		0	0	1		125	0	136
PHF	0.91	0.91	0.91		0.91	0.93	0.91		0.25	0.25	0.25		0.97	0.97	0.97
Adj flow	752	473	3		1	483	875		0	0	4		129	0	140
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	752	476				484	875			4			129	0	140
Prop LTs	1.000	0.000				0.002				0.000			1.000	0.000	
Prop RTs		0.006				0.000	1.000			1.000				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.980	0.980			0.971	0.971			0.990				0.980	0.980	0.980
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.999			1.000	0.850			0.865					1.000	0.850
fLT	0.950	1.000			0.999				1.000				0.755	1.000	
Sec.	0.143														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1711	1628			1843	1568			1844				1313	1801	1478
Sec.	257														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		684	1711	# 0.40	0.400	684	1.00
Perm		68	257	# 0.26	0.311	80	0.85
Left	L	752			0.71	764	0.98
Prot							
Perm							
Thru	TR	476	1628	0.29	0.71	1158	0.41
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1843	0.26	0.26	471	1.03
Right	R	875	1568	0.56	1.00	1568	0.56
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	4	1844	0.00	0.18	328	0.01
Right							
Southbound							
Prot							
Perm							
Left	L	129	1313	# 0.10	0.18	233	0.55
Prot							
Perm							
Thru	LT	0	1801	0.00	0.18	320	0.00
Right	R	140	1478	0.09	0.63	936	0.15

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.76

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.98	0.71	21.3	1.000	764	0.50	24.4	0.0	45.7	D		
TR	0.41	0.71	5.3	1.000	1158	0.50	0.8	0.0	6.1	A	30.4	C
Westbound												
LT	1.03	0.26	33.5	1.000	471	0.50	37.9	0.0	71.4	E	25.9	C
R	0.56	1.00	0.0	0.950	1568	0.50	0.8	0.0	0.8	A		
Northbound												
LTR	0.01	0.18	30.5	1.000	328	0.50	0.1	0.0	30.6	C	30.6	C
Southbound												
L	0.55	0.18	33.7	1.000	233	0.50	9.2	0.0	42.9	D		
LT	0.00	0.18	30.4	1.000	320	0.50	0.0	0.0	30.4	C	24.2	C

R 0.15 0.63 6.7 1.000 936 0.50 0.3 0.0 7.0 A

Intersection delay = 27.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	28.0			16.0
Opposing effective green time, go (s)	23.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	752			129
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.00			0.00
Adjusted opposing flow rate, Vo (veh/h)	484			4
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	18.80			3.23
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.10			0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.74			0.82
gq, (see Exhibit C16-4,5,6,7,8)	24.64			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	3.36			16.00
n=Max(gq-gf)/2,0)	12.32			0.00
PTHo=1-PLTo	1.00			1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	2.05			1.32
EL2=Max((1-Ptho**n)/Plto, 1.0)	12.18			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14			0.25
gdiff=max(gq-gf,0)	24.64			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14			0.76
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.143			0.755

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		23.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		23.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	0	0
Proportion of LT in LT lane group, PLT	0.000	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	476	0	4
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.03	0.00	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.90	0.00	0.10
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.6	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.40	16.00	16.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	0.00
EL1 (refer to Exhibit C16-3)	2.25	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.09	0.13	0.13
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.999	1.000	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		23.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		476		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.002		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.006
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	752			
v/c ratio from Capacity Worksheet, X	0.98			
Protected phase effective green interval, g (s)	36.0			
Opposing queue effective green interval, gq	20.64			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	29.4			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.475			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.51			
XPerm	2.52			
XProt	0.80			
Case	3			
Queue at beginning of green arrow, Qa	9.24			
Queue at beginning of unsaturated green, Qu	4.31			
Residual queue, Qr	3.11			
Uniform Delay, d1	21.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.3	0.00	0.0	0.0	45.7
TR	0.0	0.00	13.0	5.3	0.00	0.0	0.0	6.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	33.5	33.5	0.00	3.3	0.0	71.4
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.5	0.00	0.0	0.0	30.6
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	33.7	0.00	0.0	0.0	42.9
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	16.5	6.7	0.00	0.0	0.0	7.0

Intersection Delay	27.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R		LTR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	752	476		484	875		4	129	0	140
So	1900	1900		1900	1900		1900	1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	1
SL	1075	1628		1843	1568		1844	1313	1801	1478
LnCapacity	764	1158		471	1568		328	233	320	936
Flow Ratio	0.7	0.3		0.3	0.6		0.0	0.1	0.0	0.1
v/c Ratio	0.98	0.41		1.03	0.56		0.01	0.55	0.00	0.15
Grn Ratio	0.71	0.71		0.26	1.00		0.18	0.18	0.18	0.63
I Factor		0.735		0.546			1.000		1.000	
AT or PVG	3	3		3	3		3	3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00		1.00			1.00	1.00	1.00	1.00
Q1	9.0	4.9		12.1			0.1	2.9	0.0	1.4
kB	0.7	0.9		0.4	0.9		0.5	0.4	0.5	1.1
Q2	7.4	0.6		5.6	1.1		0.0	0.5	0.0	0.2
Q Average	16.3	5.5		17.7			0.1	3.4	0.0	1.6
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0		0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2			1.3	1.3	1.3	1.3
BOQ	19.7	6.8		21.3			0.1	4.3	0.0	2.0
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4			1.7	1.6	1.7	1.6
BOQ	23.0	8.3		24.9			0.2	5.3	0.0	2.6
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5			2.0	1.8	2.0	1.9
BOQ	24.8	9.2		26.8			0.2	6.0	0.0	3.0
QSRatio										
95th Percentile Output:										
fB%	1.6	1.9		1.6			2.6	2.1	2.6	2.3
BOQ	26.7	10.6		28.8			0.2	7.2	0.0	3.7
QSRatio										
98th Percentile Output:										
fB%	1.8	2.2		1.7			3.2	2.5	3.2	2.8
BOQ	28.7	12.1		30.9			0.3	8.4	0.0	4.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/22/2013	Jurisd: Staten Island, NY
Period: Weekday 12-1 PM MD Peak Hour	Year : 2020 Miti-Action Alt
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR		DefL	TR			LT	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	819	2006	0.70	0.50	23.5	C		
TR	1056	2111	0.04	0.50	11.5	B	22.7	C

LTR	1024	3071	0.13	0.33	21.1	C	21.1	C
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Northbound								
DefL	517	1329	0.01	0.39	16.9	B		
TR	732	1881	0.01	0.39	16.9	B	16.9	B

LT	539	1386	0.14	0.39	18.3	B	72.5	E
R	881	1524	1.09	0.58	76.9	E		

Intersection Delay = 51.4 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	519	38	0	2	64	71	4	3	0	64	6	1178
% Heavy Veh	2	2	2	3	3	3	1	1	1	6	6	6
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
PK 15 Vol	143	10	0	1	18	20	2	1	0	18	2	327
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900		1900	1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0			0	1
LGConfig		DefL	TR			LTR		DefL	TR		LT	R
Lane Width	16.0	16.0			11.5		12.0	12.0			12.0	12.0
RTOR Vol			0			17			0			310
Adj Flow	570	42			131		7	5			78	964
%InSharedLn												
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0		0	0			0	0
%InProtPhase	0.0											0.0
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0		0.0	0.0			0.0	0.0
Arriv. Type	3	3			3		3	3			3	3
Unit Ext.	3.0	3.0			3.0		3.0	3.0			3.0	3.0
I Factor		0.962			1.000			1.000			0.889	
Lost Time	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ext of g	2.0	2.0			2.0		2.0	2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	519	38	0	2	64	71	4	3	0	64	6	1178
PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.58	0.58	0.58	0.90	0.90	0.90
Adj flow	570	42	0	2	70	59	7	5	0	71	7	964
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR		DefL	TR			LT	R
Adj flow	570	42			131		7	5			78	964
Prop LTs	1.000	0.000			0.015		1.000	0.000			0.910	
Prop RTs		0.000			0.450			0.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	DefL	TR	LTR		DefL	TR	LT	R
So	1900	1900	1900		1900	1900	1900	1900
Lanes	0	2	0	0	2	0	0	1
fW	1.133	1.133	0.983		1.000	1.000	1.000	1.000
fHV	0.980	0.980	0.971		0.990	0.990	0.943	0.943
fG	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000		1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.952		1.000	1.000	1.000	1.000
fRT		1.000	0.932			1.000	1.000	0.850
fLT	0.950	1.000	0.954		0.706	1.000	0.773	
Sec.	0.669							
fLpb	1.000	1.000	1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	1.000
S	2006	2111	3071		1329	1881	1386	1524
Sec.	1413							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	130	2006	0.06	0.189	379	0.34
Perm		440	1413	# 0.31	0.311	440	1.00
Left		570			0.50	819	0.70
Prot	TR	42	2111	0.02	0.50	1056	0.04
Perm							
Thru							
Right	LTR	131	3071	0.04	0.33	1024	0.13
Prot							
Perm							
Left	DefL	7	1329	0.01	0.39	517	0.01
Prot							
Perm							
Thru	TR	5	1881	0.00	0.39	732	0.01
Prot							
Perm							
Thru	LT	78	1386	0.06	0.39	539	0.14
Prot							
Perm							
Left	R	964	1524	# 0.63	0.58	881	1.09
Prot							
Perm							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.94
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.06

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.70	0.50	18.8	1.000	819	0.50	4.7	0.0	23.5	C			
TR	0.04	0.50	11.5	1.000	1056	0.50	0.1	0.0	11.5	B	22.7	C	
Westbound													
LTR	0.13	0.33	20.9	1.000	1024	0.50	0.3	0.0	21.1	C	21.1	C	
Northbound													
DefL	0.01	0.39	16.9	1.000	517	0.50	0.0	0.0	16.9	B			
TR	0.01	0.39	16.9	1.000	732	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.14	0.39	17.8	1.000	539	0.50	0.5	0.0	18.3	B	72.5	E	

R 1.09 0.58 19.0 1.000 881 0.50 57.9 0.0 76.9 E

Intersection delay = 51.4 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0		35.0	
Effective permitted green time for LT lane group, g(s)	28.0		35.0	
Opposing effective green time, go (s)	30.0		35.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	2		1	
Adjusted LT flow rate, VLT (veh/h)	570		7	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.02		0.91	
Adjusted opposing flow rate, Vo (veh/h)	131		78	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/3600	14.25		0.17	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.72		1.95	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67		0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00		0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00		35.00	
n=Max(gq-gf)/2,0)	0.00		0.00	
PTHo=1-PLTo	0.98		0.09	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	1.49		1.42	
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00		1.00	
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14		0.11	
gdifff=max(gq-gf,0)	0.00		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67		0.71	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.669		0.706	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		30.0		35.0
Effective permitted green time for LT lane group, g(s)		30.0		35.0
Opposing effective green time, go (s)		45.0		35.0
Number of lanes in LT lane group, N		2		1

Number of lanes in opposing approach, No	2	2
Adjusted LT flow rate, VLT (veh/h)	2	71
Proportion of LT in LT lane group, PLT	0.000	0.015 0.000 0.910
Proportion of LT in opposing flow, PLTo	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	42	5
Lost time for LT lane group, tL	3.00	5.00
Computation		
LT volume per cycle, LTC=VLTC/3600	0.05	1.78
Opposing lane util. factor, fLUo	0.952	1.000 1.000 1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.52	0.06
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	24.1	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	5.93	30.75
n=Max(gq-gf)/2,0)	0.00	0.00
PTHo=1-PLTo	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.91
EL1 (refer to Exhibit C16-3)	1.44	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.11
gdifff=max(gq-gf,0)	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)		
or flt=[fm+0.91(N-1)]/N**		
Left-turn adjustment, fLT	0.954	0.773

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	131	42	78	5
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.015	1.000	0.910
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	30.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.450	0.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	570			
v/c ratio from Capacity Worksheet, X	0.70			
Protected phase effective green interval, g (s)	17.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	28.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.16			
Protected ph. departure rate, Sp=s/3600	0.557			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.39			
XPerm	1.05			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	0.57			
Queue at beginning of unsaturated green, Qu	7.13			
Residual queue, Qr	0.00			
Uniform Delay, d1	18.8			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00		18.8	0.00	0.0	0.0	23.5
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	30.0	20.9	0.00	0.0	0.0	21.1
	0.0						0.0	
Northbound								
DefL	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
TR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.8	0.00	0.0	0.0	18.3
R	0.0	0.00	19.0	19.0	0.00	20.7	0.0	76.9
Intersection Delay			51.4	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound			Northbound			Southbound	
LaneGroup	DefL	TR			LTR			DefL	TR		LT	R
Init Queue	0.0	0.0			0.0			0.0	0.0		0.0	0.0
Flow Rate	570	42			68			7	5		78	964
So	1900	1900			1900			1900	1900		1900	1900
No.Lanes	0	2	0	0	2	0		0	2	0	0	1
SL	1637	2111			1612			1329	1881		1386	1524
LnCapacity	819	1056			537			517	732		539	881
Flow Ratio	0.3	0.0			0.0			0.0	0.0		0.1	0.6
v/c Ratio	0.70	0.04			0.13			0.01	0.01		0.14	1.09
Grn Ratio	0.50	0.50			0.33			0.39	0.39		0.39	0.58
I Factor		0.962			1.000				1.000		0.889	
AT or PVG	3	3			3			3	3		3	3
Pltn Ratio	1.00	1.00			1.00			1.00	1.00		1.00	1.00
PF2	1.00	1.00			1.00			1.00	1.00		1.00	1.00
Q1	8.2	0.5			1.2			0.1	0.1		1.3	24.1
kB	1.0	1.1			0.7			0.7	0.9		0.7	0.9
Q2	2.1	0.0			0.1			0.0	0.0		0.1	17.0
Q Average	10.3	0.6			1.3			0.1	0.1		1.4	41.1
Q Spacing	25.0	25.0			25.0			25.0	25.0		25.0	25.0
Q Storage	0	0			0			0	0		0	0
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.3			1.3			1.3	1.3		1.3	1.2
BOQ	12.4	0.8			1.6			0.2	0.1		1.8	49.3
QSRatio												
85th Percentile Output:												
fB%	1.4	1.7			1.6			1.7	1.7		1.6	1.4
BOQ	14.8	1.0			2.1			0.2	0.1		2.2	57.5
QSRatio												
90th Percentile Output:												
fB%	1.6	1.9			1.9			2.0	2.0		1.9	1.5
BOQ	16.0	1.1			2.4			0.2	0.2		2.6	61.6
QSRatio												
95th Percentile Output:												
fB%	1.7	2.5			2.4			2.6	2.6		2.4	1.6
BOQ	17.7	1.5			3.1			0.3	0.2		3.2	65.7
QSRatio												
98th Percentile Output:												
fB%	1.9	3.0			2.9			3.2	3.2		2.8	1.7
BOQ	19.4	1.8			3.7			0.4	0.3		3.9	69.8
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/22/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	10		147	230	469	127	111	171		353		32
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left		P			SB Left			
Thru		P			Thru	P		
Right		P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	9.0	16.0				20.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	250	1668	0.05	0.15	22.2	C	40.5	D
R	248	1652	0.77	0.15	41.8	D		
Westbound								
LTR	1260	4726	0.75	0.27	23.3	C	23.3	C
Northbound								
L	163	489	0.77	0.33	45.0	D		
T	593	1778	0.32	0.33	16.3	B	27.6	C
Southbound								
TR	690	2070	0.62	0.33	20.2	C	20.2	C

Intersection Delay = 25.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	10		147	230	469	127	111	171		353	32	
% Heavy Veh	1		1	2	2	2	6	6		2	2	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
PK 15 Vol	3		48	66	135	36	31	48		98	9	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L		T		TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	13		191		949		125	192			428	
%InSharedLn												
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000		0.084		
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.830			0.725			0.937			0.817	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left		P			SB	Left		
	Thru		P				Thru	P	
	Right		P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		9.0	16.0					20.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	10		147	230	469	127	111	171		353	32	
PHF	0.77		0.77	0.87	0.87	0.87	0.89	0.89		0.90	0.90	
Adj flow	13		191	264	539	146	125	192		392	36	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	13		191		949		125	192			428	
Prop LTs					0.278		1.000	0.000			0.000	
Prop RTs			1.000		0.154			0.000			0.084	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.943	0.943	0.980	0.980
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	0.992	0.992	0.992
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.977	0.977		1.000	0.989	0.989
fLT	0.950		0.986	0.986	0.273	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	1668	1652	4726	4726	489	1778	2070	2070
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	13	1668	0.01	0.15	250	0.05
Prot							
Perm							
Thru							
Right	R	191	1652	# 0.12	0.15	248	0.77
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	949	4726	# 0.20	0.27	1260	0.75
Right							
Northbound							
Prot							
Perm							
Left	L	125	489	# 0.26	0.33	163	0.77
Prot							
Perm							
Thru	T	192	1778	0.11	0.33	593	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	428	2070	0.21	0.33	690	0.62
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.57
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.05	0.15	21.8	1.000	250	0.50	0.3	0.0	22.2	C	40.5	D	
R	0.77	0.15	24.5	1.000	248	0.50	17.3	0.0	41.8	D			
Westbound													
LTR	0.75	0.27	20.2	1.000	1260	0.50	3.1	0.0	23.3	C	23.3	C	
Northbound													
L	0.77	0.33	17.9	1.000	163	0.50	27.1	0.0	45.0	D	27.6	C	
T	0.32	0.33	14.9	1.000	593	0.50	1.4	0.0	16.3	B			
Southbound													
TR	0.62	0.33	16.8	1.000	690	0.50	3.4	0.0	20.2	C	20.2	C	

Intersection delay = 25.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)			20.0	
Effective permitted green time for LT lane group, g(s)			20.0	
Opposing effective green time, go (s)			20.0	
Number of lanes in LT lane group, N			1	
Number of lanes in opposing approach, No			1	
Adjusted LT flow rate, VLT (veh/h)			125	
Proportion of LT in LT lane group, PLT			1.000	
Proportion of LT in opposing flow, PLTo			0.00	
Adjusted opposing flow rate, Vo (veh/h)			428	
Lost time for LT lane group, tL			5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600			2.08	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)			7.13	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g			0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)			1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]			0.67	
gq, (see Exhibit C16-4,5,6,7,8)			9.37	
gu=g-gq if gq>=gf, or = g-gf if gq<gf			10.63	
n=Max(gq-gf)/2,0)			4.68	
PTHo=1-PLTo			1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]			1.00	
EL1 (refer to Exhibit C16-3)			1.95	
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g			0.20	
gdifff=max(gq-gf,0)			0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)			0.27	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT			0.273	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.278 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 PTHo=1-PLTo
 $PL^* = PLT[1 + (N-1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N-1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			20.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.37	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.468	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			428	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	16.0		20.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	16.0		20.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.154	0.084
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	25.5	21.8	0.00	0.0	0.0	22.2
	0.0						0.0	
R	0.0	0.00	25.5	24.5	0.00	0.0	0.0	41.8
Westbound								
	0.0						0.0	
LTR	0.0	0.00	22.0	20.2	0.00	0.0	0.0	23.3
	0.0						0.0	
Northbound								
L	0.0	0.00	20.0	17.9	0.00	0.0	0.0	45.0
T	0.0	0.00	20.0	14.9	0.00	0.0	0.0	16.3
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	20.0	16.8	0.00	0.0	0.0	20.2
	0.0						0.0	
Intersection Delay			25.2	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound			Southbound
LaneGroup	L	R		LTR		L	T		TR
Init Queue	0.0	0.0		0.0		0.0	0.0		0.0
Flow Rate	13	191		348		125	192		428
So	1900	1900		1900		1900	1900		1900
No.Lanes	1	0	1	0	3	0	1	1	0
SL	1668	1652		1734		489	1778		2070
LnCapacity	250	248		462		163	593		690
Flow Ratio	0.0	0.1		0.2		0.3	0.1		0.2
v/c Ratio	0.05	0.77		0.75		0.77	0.32		0.62
Grn Ratio	0.15	0.15		0.27		0.33	0.33		0.33
I Factor		0.830		0.725			0.937		0.817
AT or PVG	3	3		3		3	3		3
Pltn Ratio	1.00	1.00		1.00		1.00	1.00		1.00
PF2	1.00	1.00		1.00		1.00	1.00		1.00
Q1	0.2	3.1		5.3		1.9	2.4		6.0
kB	0.3	0.3		0.4		0.2	0.6		0.5
Q2	0.0	0.8		1.0		0.7	0.3		0.9
Q Average	0.2	3.9		6.4		2.5	2.7		6.9
Q Spacing	25.0	25.0		25.0		25.0	25.0		25.0
Q Storage	0	0		0		0	0		0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2		1.2		1.3	1.3		1.2
BOQ	0.3	4.8		7.8		3.2	3.3		8.4
QSRatio									
85th Percentile Output:									
fB%	1.7	1.5		1.5		1.6	1.6		1.5
BOQ	0.3	6.0		9.4		4.0	4.2		10.1
QSRatio									
90th Percentile Output:									
fB%	2.0	1.7		1.6		1.8	1.8		1.6
BOQ	0.4	6.7		10.4		4.5	4.8		11.2
QSRatio									
95th Percentile Output:									
fB%	2.6	2.1		1.9		2.2	2.2		1.9
BOQ	0.5	8.0		12.0		5.6	5.8		12.7
QSRatio									
98th Percentile Output:									
fB%	3.1	2.4		2.1		2.6	2.6		2.1
BOQ	0.6	9.3		13.5		6.6	6.9		14.3
QSRatio									

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 5 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/22/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 Miti-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	204		188	209		234	195		191			
Lane Width	16.0			11.0	11.0			11.0				
RTOR Vol			44						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left		P			SB Left			
Thru		P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	45.0					35.0		
Yellow	3.0					3.0		
All Red	2.0					2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	923	1845	0.42	0.50	15.6	B	15.6	B
----	-----	------	------	------	------	---	------	---

Westbound

L	344	687	0.67	0.50	26.7	C		
T	792	1583	0.32	0.50	14.5	B	20.3	C

Northbound

LR	558	1434	0.79	0.39	34.2	C	34.2	C
----	-----	------	------	------	------	---	------	---

Southbound

Intersection Delay = 23.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		204	188	209	234		195		191			
% Heavy Veh		8	8	16	16		2		2			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
PK 15 Vol		57	52	57	64		55		54			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		11.0	11.0			11.0				
RTOR Vol			44						0			
Adj Flow		387		230	257			439				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.506				
Prop RTs		0.413			0.000			0.494				
Peds Bikes		0						0		0		
Buses		5		0	0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.961			0.989			0.922				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left	P	
	Thru	P						Thru		
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right							Right		
	Peds							Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		45.0							35.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		204	188	209	234		195		191			
PHF		0.90	0.90	0.91	0.91		0.88		0.88			
Adj flow		227	160	230	257		222		217			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		387		230	257			439				
Prop LTs		0.000		1.000	0.000			0.506				
Prop RTs		0.413			0.000			0.494				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.967 0.967		0.967			
fHV	0.926		0.862 0.862		0.980			
fG	1.000		1.000 1.000		1.000			
fP	1.000		1.000 1.000		0.875			
fBB	0.980		1.000 1.000		1.000			
fA	1.000		1.000 1.000		1.000			
fLU	1.000		1.000 1.000		1.000			
fRT	0.944		1.000		0.933			
fLT	1.000		0.434 1.000		0.975			
Sec.								
fLpb	1.000		1.000 1.000		1.000			
fRpb	1.000		1.000		1.000			
S	1845		687 1583		1434			
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	387	1845	0.21	0.50	923	0.42
Right							
Westbound							
Prot							
Perm							
Left	L	230	687	# 0.33	0.50	344	0.67
Prot							
Perm							
Thru	T	257	1583	0.16	0.50	792	0.32
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	439	1434	# 0.31	0.39	558	0.79
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination

Eastbound												
TR	0.42	0.50	14.2	1.000	923	0.50	1.3	0.0	15.6	B	15.6	B
Westbound												
L	0.67	0.50	16.9	1.000	344	0.50	9.8	0.0	26.7	C		
T	0.32	0.50	13.4	1.000	792	0.50	1.1	0.0	14.5	B	20.3	C
Northbound												
LR	0.79	0.39	24.2	1.000	558	0.50	9.9	0.0	34.2	C	34.2	C
Southbound												

Intersection delay = 23.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		45.0		
Opposing effective green time, go (s)		45.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		230		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		387		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		5.75		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		9.68		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.50		
gq, (see Exhibit C16-4,5,6,7,8)		8.36		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		36.64		
n=Max(gq-gf)/2,0)		4.18		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.88		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.09		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.43		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.434		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.506
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

EBLT WBLT NBLT SBLT

Cycle length, C

90.0 sec

Adj. LT vol from Vol Adjustment Worksheet, v

v/c ratio from Capacity Worksheet, X

Protected phase effective green interval, g (s)

Opposing queue effective green interval, gq

Unopposed green interval, gu

Red time $r=(C-g-gq-gu)$

Arrival rate, $qa=v/(3600(\max[X,1.0]))$

Protected ph. departure rate, $Sp=s/3600$

Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$

XPerm

XProt

Case

Queue at beginning of green arrow, Qa

Queue at beginning of unsaturated green, Qu

Residual queue, Qr

Uniform Delay, d1

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet	Dur. Unmet	Uniform Delay		Initial	Final	Initial	Lane
	Demand Q veh	Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
TR	0.0						0.0	
	0.0	0.00	22.5	14.2	0.00	0.0	0.0	15.6
	0.0						0.0	
Westbound								
L	0.0	0.00	22.5	16.9	0.00	0.0	0.0	26.7
T	0.0	0.00	22.5	13.4	0.00	0.0	0.0	14.5
	0.0						0.0	
Northbound								
LR	0.0						0.0	
	0.0	0.00	27.5	24.2	0.00	0.0	0.0	34.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			23.5	sec/veh	Intersection LOS C			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound		
LaneGroup	TR		L	T	LR				
Init Queue	0.0		0.0	0.0	0.0				
Flow Rate	387		230	257	439				
So	1900		1900	1900	1900				
No.Lanes	0	1	0	1	0	0	0	0	0
SL	1845		687	1583	1434				
LnCapacity	923		344	792	558				
Flow Ratio	0.2		0.3	0.2	0.3				
v/c Ratio	0.42		0.67	0.32	0.79				
Grn Ratio	0.50		0.50	0.50	0.39				
I Factor	0.961			0.989	0.922				
AT or PVG	3		3	3	3				
Pltn Ratio	1.00		1.00	1.00	1.00				
PF2	1.00		1.00	1.00	1.00				
Q1	6.1		4.3	3.8	9.7				
kB	1.0		0.5	1.0	0.7				
Q2	0.7		1.0	0.5	2.2				
Q Average	6.9		5.3	4.3	11.9				
Q Spacing	25.0		25.0	25.0	25.0				
Q Storage	0		0	0	0				
Q S Ratio									
70th Percentile Output:									
fB%	1.2		1.2	1.2	1.2				
BOQ	8.4		6.6	5.3	14.4				
QSRatio									
85th Percentile Output:									
fB%	1.5		1.5	1.5	1.4				
BOQ	10.1		8.0	6.6	17.0				
QSRatio									
90th Percentile Output:									
fB%	1.6		1.7	1.7	1.5				
BOQ	11.2		8.9	7.3	18.4				
QSRatio									
95th Percentile Output:									
fB%	1.9		1.9	2.0	1.7				
BOQ	12.7		10.4	8.7	20.2				
QSRatio									
98th Percentile Output:									
fB%	2.1		2.2	2.3	1.8				
BOQ	14.3		11.8	10.0	21.9				
QSRatio									

ERROR MESSAGES

No errors to report.

Weekday

PM

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume			344	53		43	349		
Peak-Hour Factor, PHF			0.87	0.87		0.81	0.81		
Hourly Flow Rate, HFR			395	60		53	430		
Percent Heavy Vehicles			--	--		7	--	--	
Median Type/Storage		Undivided			/				
RT Channelized?				No					
Lanes			1	1		1	1		
Configuration			T	R		L	T		
Upstream Signal?			No				No		
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		55		49					
Peak Hour Factor, PHF		0.68		0.68					
Hourly Flow Rate, HFR		80		72					
Percent Heavy Vehicles		7		7					
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/			/	
Lanes		1		1					
Configuration		L		R					

Delay, Queue Length, and Level of Service

Approach	NB	SB	Westbound				Eastbound		
Movement	1	4	7	8	9	10	11	12	
Lane Config		L	L		R				
v (vph)	53	80			72				
C(m) (vph)	1080	276			643				
v/c	0.05	0.29			0.11				
95% queue length	0.15	1.17			0.38				
Control Delay	8.5	23.3			11.3				
LOS	A	C			B				
Approach Delay				17.6					
Approach LOS				C					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		344	53	43	349	
Peak-Hour Factor, PHF		0.87	0.87	0.81	0.81	
Peak-15 Minute Volume		99	15	13	108	
Hourly Flow Rate, HFR		395	60	53	430	
Percent Heavy Vehicles		--	--	7	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	55		49			
Peak Hour Factor, PHF	0.68		0.68			
Peak-15 Minute Volume	20		18			
Hourly Flow Rate, HFR	80		72			
Percent Heavy Vehicles	7		7			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		7	7		7			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.5		6.3			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		7	7		7			
t(f)		2.3	3.6		3.4			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked

	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)

alpha
beta
Travel time, t(a) (sec)
Smoothing Factor, F
Proportion of conflicting flow, f
Max platooned flow, V(c,max)
Min platooned flow, V(c,min)
Duration of blocked period, t(p)
Proportion time blocked, p

	0.000	0.000
--	-------	-------

Computation 3-Platoon Event Periods Result

p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
--	-----------------------------	-------------------------------------	----------------------------

p(1)
p(4)
p(7)
p(8)
p(9)
p(10)
p(11)
p(12)

Computation 4 and 5
Single-Stage Process

Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
----------	--------	--------	--------	--------	--------	---------	---------	---------

V c,x		455	931		395			
s								
Px								
V c,u,x								

C r,x
C plat,x

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	395	
Potential Capacity	643	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	643	
Probability of Queue free St.	0.89	1.00

Step 2: LT from Major St.	4	1
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Conflicting Flows	455	
Potential Capacity	1080	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1080	
Probability of Queue free St.	0.95	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
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Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.95	0.95
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
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Conflicting Flows	931	
Potential Capacity	290	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.95
Maj. L, Min T Adj. Imp Factor.		0.96
Cap. Adj. factor due to Impeding mvmnt	0.95	0.85
Movement Capacity	276	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
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Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor 1.00 1.00
 Cap. Adj. factor due to Impeding mvmnt 0.95 0.95
 Movement Capacity

Result for 2 stage process:
 a
 y
 C t
 Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 2 - Second Stage
 Conflicting Flows
 Potential Capacity
 Pedestrian Impedance Factor
 Cap. Adj. factor due to Impeding mvmnt
 Movement Capacity

Part 3 - Single Stage
 Conflicting Flows 931
 Potential Capacity 290
 Pedestrian Impedance Factor 1.00 1.00
 Maj. L, Min T Impedance factor 0.95
 Maj. L, Min T Adj. Imp Factor. 0.96
 Cap. Adj. factor due to Impeding mvmnt 0.95 0.85
 Movement Capacity 276

Results for Two-stage process:
 a
 y
 C t 276

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	80		72			
Movement Capacity (vph)	276		643			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	276		643			
Volume	80		72			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		53	80		72			
C(m) (vph)		1080	276		643			
v/c		0.05	0.29		0.11			
95% queue length		0.15	1.17		0.38			
Control Delay		8.5	23.3		11.3			
LOS		A	C		B			
Approach Delay				17.6				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.95
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.5
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/19/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	1	11	2	377	20	386	4	167	362	308	278	1
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	725	1740	0.02	0.42	10.4	B	10.4	B
Westbound								
LT	528	1268	0.92	0.42	38.6	D	37.5	D
R	523	1256	0.90	0.42	36.4	D		
Northbound								
LT	740	1777	0.25	0.42	12.1	B	15.8	B
R	641	1538	0.61	0.42	17.6	B		
Southbound								
L	443	1063	0.81	0.42	30.0	C		
TR	709	1702	0.46	0.42	14.7	B	22.8	C

Intersection Delay = 27.2 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/19/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	377	20	386	4	167	362	308	278	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	115	6	118	1	45	97	90	81	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900	1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			484	471		184	389	358	324	
%InSharedLn												
Prop LTs		0.063			0.950			0.022		1.000	0.000	
Prop RTs		0.125			0.000	1.000		0.000	1.000		0.003	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3	0	0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	377	20	386	4	167	362	308	278	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	460	24	471	4	180	389	358	323	1
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	16			484 471			184 389			358 324		
Prop LTs	0.063			0.950			0.022			1.000 0.000		
Prop RTs	0.125			0.000 1.000			0.000 1.000			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.971			0.952 0.952			0.952 0.952			0.935 0.935		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988 1.000			1.000 0.992		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.983			1.000 0.850			1.000 0.850			1.000		
fLT	0.982			0.725			0.994			0.641 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1740			1268 1256			1777 1538			1063 1702		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1740	0.01	0.42	725	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	484	1268	# 0.38	0.42	528	0.92
Right	R	471	1256	0.38	0.42	523	0.90
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	184	1777	0.10	0.42	740	0.25
Right	R	389	1538	0.25	0.42	641	0.61
Southbound							
Prot							
Perm							
Left	L	358	1063	# 0.34	0.42	443	0.81
Prot							
Perm							
Thru	TR	324	1702	0.19	0.42	709	0.46
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.72
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.86

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				Factor	Del d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	725	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.92	0.42	16.5	1.000	528	0.50	22.0	0.0	38.6	D	37.5	D
R	0.90	0.42	16.3	1.000	523	0.50	20.1	0.0	36.4	D		
Northbound												
LT	0.25	0.42	11.4	1.000	740	0.50	0.7	0.0	12.1	B	15.8	B
R	0.61	0.42	13.7	1.000	641	0.50	3.9	0.0	17.6	B		
Southbound												
L	0.81	0.42	15.4	1.000	443	0.50	14.6	0.0	30.0	C		
TR	0.46	0.42	12.6	1.000	709	0.50	2.1	0.0	14.7	B	22.8	C

Intersection delay = 27.2 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				358
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				184
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.97
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.07
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf				25.00
n=Max(gq-gf)/2,0)				0.00
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.56
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.16
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.64
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.641

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	460	4	
Proportion of LT in LT lane group, PLT	0.063	0.950	0.022	0.000
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.00	
Adjusted opposing flow rate, Vo (veh/h)	484	16	324	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.67	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.07	0.27	5.40	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	17.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	8.69	0.00	2.68	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	7.97	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.05	0.94	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.02	
EL1 (refer to Exhibit C16-3)	2.26	1.40	1.93	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.725	0.994	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.69		2.68	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.348		0.107	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	484		324	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.022	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	16.5	0.00	0.0	0.0	38.6
R	0.0	0.00	17.5	16.3	0.00	0.0	0.0	36.4
Northbound								
	0.0						0.0	
LT	0.0	0.00	17.5	11.4	0.00	0.0	0.0	12.1
R	0.0	0.00	17.5	13.7	0.00	0.0	0.0	17.6
Southbound								
L	0.0	0.00	17.5	15.4	0.00	0.0	0.0	30.0
TR	0.0	0.00	17.5	12.6	0.00	0.0	0.0	14.7
	0.0						0.0	
Intersection Delay			27.2	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16		484	471	184	389	358	324
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	0	
SL	1740		1268	1256	1777	1538	1063	1702
LnCapacity	725		528	523	740	641	443	709
Flow Ratio	0.0		0.4	0.4	0.1	0.3	0.3	0.2
v/c Ratio	0.02		0.92	0.90	0.25	0.61	0.81	0.46
Grn Ratio	0.42		0.42	0.42	0.42	0.42	0.42	0.42
I Factor	1.000		0.933		0.919		1.000	
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.2		7.6	7.3	2.0	5.1	5.2	3.9
kB	0.7		0.5	0.5	0.6	0.6	0.5	0.7
Q2	0.0		3.5	3.1	0.2	0.9	1.8	0.6
Q Average	0.2		11.1	10.5	2.2	5.9	7.0	4.5
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.2
BOQ	0.2		13.4	12.7	2.8	7.3	8.6	5.5
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.4	1.6	1.5	1.5	1.5
BOQ	0.3		15.9	15.0	3.5	8.8	10.3	6.8
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.8	1.7	1.6	1.7
BOQ	0.3		17.2	16.3	4.0	9.8	11.4	7.6
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	1.7	2.2	1.9	1.8	2.0
BOQ	0.4		18.9	18.0	5.0	11.3	12.9	9.0
QSRatio								
98th Percentile Output:								
fB%	3.1		1.9	1.9	2.7	2.2	2.1	2.3
BOQ	0.5		20.6	19.7	5.9	12.8	14.5	10.3
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road

Inter.: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				134		186	592	105		154	749	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		17.0					33.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 421 1486 0.90 0.28 44.4 D 44.4 D

Northbound

TR 1065 1937 0.70 0.55 13.1 B 13.1 B

Southbound

L 249 453 0.72 0.55 12.1 B
 T 913 1660 0.95 0.55 16.7 B 15.9 B

Intersection Delay = 19.9 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				134		186	592	105		154	749	
% Heavy Veh				1		1	4	4		6	6	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
PK 15 Vol				40		55	159	28		45	218	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					381			750		179	871	
%InSharedLn												
Prop LTs					0.420			0.000		1.000	0.000	
Prop RTs					0.580			0.151			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			4		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.901			0.798				0.114	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		17.0							33.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				134		186	592	105		154	749	
PHF				0.84		0.84	0.93	0.93		0.86	0.86	
Adj flow				160		221	637	113		179	871	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					381			750		179	871	
Prop LTs					0.420			0.000		1.000	0.000	
Prop RTs					0.580			0.151			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.990			0.962			0.943	0.943	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.984			1.000	0.992	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.922			0.980				1.000	
fLT				0.979			1.000			0.271	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1486			1937			453	1660	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	381	1486	# 0.26	0.28	421	0.90
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	750	1937	0.39	0.55	1065	0.70
Right							
Southbound							
Prot							
Perm							
Left	L	179	453	0.40	0.55	249	0.72
Prot							
Perm							
Thru	T	871	1660	# 0.52	0.55	913	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.78
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.94

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.90	0.28	20.7	1.000	421	0.50	23.6	0.0	44.4	D	44.4	D
Northbound												
TR	0.70	0.55	9.9	1.000	1065	0.50	3.1	0.0	13.1	B	13.1	B
Southbound												
L	0.72	0.55	10.0	1.000	249	0.50	2.1	0.0	12.1	B		
T	0.95	0.55	12.8	1.000	913	0.50	3.9	0.0	16.7	B	15.9	B

Intersection delay = 19.9 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				33.0
Effective permitted green time for LT lane group, g(s)				33.0
Opposing effective green time, go (s)				33.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				179
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				750
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.98
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				12.50
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.45
gq, (see Exhibit C16-4,5,6,7,8)				9.52
gu=g-gq if gq>=gf, or = g-gf if gq<gf				23.48
n=Max(gq-gf)/2,0)				4.76
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.63
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/h				0.12
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.27
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.271

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.420 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin; max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin ≤ fm ≤ 1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				33.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				9.52
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.288
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				750
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	17.0		33.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Conflicting bicycle volume, Vbic (bicycles/h)	0		0	
Vpedg	0		0	
OCCpedg	0.000		0.000	
Effective green, g (s)	17.0		33.0	
Vbicg	0		0	

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.580	0.151
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	21.5	20.7	0.00	0.0	0.0	44.4
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	13.5	9.9	0.00	0.0	0.0	13.1
	0.0						0.0	
Southbound								
L	0.0	0.00	13.5	10.0	0.00	0.0	0.0	12.1
T	0.0	0.00	13.5	12.8	0.00	0.0	0.0	16.7
	0.0						0.0	

Intersection Delay	19.9	sec/veh	Intersection LOS	B
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup										L	T	
Init Queue										0.0	0.0	
Flow Rate										179	871	
So										1900	1900	
No.Lanes	0	0	0	0	0	0	0	1	0	1	1	0
SL										453	1660	
LnCapacity										249	913	
Flow Ratio										0.4	0.5	
v/c Ratio										0.72	0.95	
Grn Ratio										0.55	0.55	
I Factor											0.114	
AT or PVG										3	3	
Pltn Ratio										1.00	1.00	
PF2										1.00	1.00	
Q1										2.2	13.7	
kB										0.0	0.1	
Q2										0.1	1.5	
Q Average										2.3	15.2	
Q Spacing										25.0	25.0	
Q Storage										0	0	
Q S Ratio												
70th Percentile Output:												
fB%										1.3	1.2	
BOQ										2.9	18.3	
QSRatio												
85th Percentile Output:												
fB%										1.6	1.4	
BOQ										3.7	21.5	
QSRatio												
90th Percentile Output:												
fB%										1.8	1.5	
BOQ										4.2	23.2	
QSRatio												
95th Percentile Output:												
fB%										2.2	1.6	
BOQ										5.2	25.1	
QSRatio												
98th Percentile Output:												
fB%										2.6	1.8	
BOQ										6.1	27.0	
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 FULL Mitigation Alt. 2
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	161	378	210	247	594	87	177	285	150	223	77	106
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	40.0				16.0	19.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	206	464	0.89	0.44	53.3	D		
T	836	1881	0.51	0.44	19.6	B	26.6	C
R	663	1492	0.28	0.44	16.6	B		
Westbound								
L	317	696	0.86	0.46	46.5	D		
TR	1514	3323	0.54	0.46	19.0	B	25.9	C
Northbound								
LT	623	3504	0.80	0.18	45.6	D	44.5	D
R	260	1463	0.52	0.18	40.6	D		
Southbound								
L	365	1728	0.80	0.21	50.1	D		
TR	342	1620	0.61	0.21	39.7	D	45.8	D

Intersection Delay = 33.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	161	378	210	247	594	87	177	285	150	223	77	106
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	46	107	60	69	181	27	48	77	40	73	25	35
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1950	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	183	430	188	274	817			496	134	293	208	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.383			0.000	
Prop RTS		0.000	1.000		0.114			0.000	1.000		0.514	
Peds Bikes	0			0		0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.701			0.949			1.000			0.970	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		40.0						16.0	19.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	161	378	210	247	594	87	177	285	150	223	77	106
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	183	430	188	274	724	93	190	306	134	293	101	107
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	183	430	188	274	817			496	134	293	208	
Prop LTs	1.000	0.000		1.000	0.000			0.383			0.000	
Prop RTs		0.000	1.000		0.114			0.000	1.000		0.514	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1950	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.935	0.935		0.971	0.971		0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.983		1.000	0.850			0.923	
fLT	0.255	1.000		0.409*	1.000		0.981			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	464	1881	1492	696	3323		3504	1463		1728	1620	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot Perm Left	L	183	464	# 0.39	0.44	206	0.89
Prot Perm Thru	T	430	1881	0.23	0.44	836	0.51
Right	R	188	1492	0.13	0.44	663	0.28
Westbound							
Prot Perm Left	L	274	696	0.39	0.46	317	0.86
Prot Perm Thru	TR	817	3323	0.25	0.46	1514	0.54
Right							
Northbound							
Prot Perm Left							
Prot Perm Thru	LT	496	3504	# 0.14	0.18	623	0.80
Right	R	134	1463	0.09	0.18	260	0.52
Southbound							
Prot Perm Left	L	293	1728	# 0.17	0.21	365	0.80
Prot Perm Thru	TR	208	1620	0.13	0.21	342	0.61
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.71
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.85

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.89	0.44	23.0	1.000	206	0.50	30.4	0.0	53.3	D		
T	0.51	0.44	18.0	1.000	836	0.50	1.6	0.0	19.6	B	26.6	C
R	0.28	0.44	15.9	1.000	663	0.50	0.8	0.0	16.6	B		
Westbound												
L	0.86	0.46	22.0	1.000	317	0.50	24.5	0.0	46.5	D		
TR	0.54	0.46	17.7	1.000	1514	0.50	1.3	0.0	19.0	B	25.9	C
Northbound												
LT	0.80	0.18	35.4	1.000	623	0.50	10.2	0.0	45.6	D	44.5	D
R	0.52	0.18	33.5	1.000	260	0.50	7.1	0.0	40.6	D		
Southbound												
L	0.80	0.21	33.7	1.000	365	0.50	16.4	0.0	50.1	D		
TR	0.61	0.21	32.1	1.000	342	0.50	7.6	0.0	39.7	D	45.8	D

Intersection delay = 33.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	40.0	40.0		
Effective permitted green time for LT lane group, g(s)	40.0	41.0		
Opposing effective green time, go (s)	41.0	40.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	183	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	817	430		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	4.58	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.73	10.75		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.54	0.56		
gq, (see Exhibit C16-4,5,6,7,8)	10.34	11.69		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	29.66	29.31		
n=Max(gq-gf)/2,0)	5.17	5.85		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.91	1.95		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.10	0.10		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.37		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.255	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.383 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	40.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.34			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.258			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	817			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	40.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	41.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.114
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	25.0	23.0	0.00	0.0	0.0	53.3
T	0.0	0.00	25.0	18.0	0.00	0.0	0.0	19.6
R	0.0	0.00	25.0	15.9	0.00	0.0	0.0	16.6
Westbound								
L	0.0	0.00	24.5	22.0	0.00	0.0	0.0	46.5
TR	0.0	0.00	24.5	17.7	0.00	0.0	0.0	19.0
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	37.0	35.4	0.00	0.0	0.0	45.6
R	0.0	0.00	37.0	33.5	0.00	0.0	0.0	40.6
Southbound								
L	0.0	0.00	35.5	33.7	0.00	0.0	0.0	50.1
TR	0.0	0.00	35.5	32.1	0.00	0.0	0.0	39.7
	0.0						0.0	

Intersection Delay	33.3	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	TR		LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	183	430	188	274	429		260	134	293	208
So	1900	1900	1900	1950	1900		1900	1900	1900	1900
No.Lanes	1	1	1	1	2	0	2	1	1	0
SL	464	1881	1492	696	1745		1840	1463	1728	1620
LnCapacity	206	836	663	317	795		327	260	365	342
Flow Ratio	0.4	0.2	0.1	0.4	0.2		0.1	0.1	0.2	0.1
v/c Ratio	0.89	0.51	0.28	0.86	0.54		0.80	0.52	0.80	0.61
Grn Ratio	0.44	0.44	0.44	0.46	0.46		0.18	0.18	0.21	0.21
I Factor		0.701			0.949		1.000			0.970
AT or PVG	3	3	3	3	3		3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Q1	4.2	7.7	3.0	6.2	7.7		6.2	3.0	7.0	4.7
kB	0.3	0.7	0.6	0.5	0.9		0.5	0.4	0.5	0.5
Q2	1.4	0.7	0.2	2.2	1.1		1.7	0.5	1.8	0.8
Q Average	5.6	8.5	3.2	8.3	8.8		7.9	3.5	8.8	5.5
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2	1.3	1.2	1.2		1.2	1.2	1.2	1.2
BOQ	6.9	10.3	4.0	10.2	10.7		9.7	4.4	10.7	6.8
QSRatio										
85th Percentile Output:										
fB%	1.5	1.5	1.6	1.5	1.5		1.5	1.5	1.5	1.5
BOQ	8.4	12.3	5.0	12.2	12.8		11.6	5.4	12.8	8.2
QSRatio										
90th Percentile Output:										
fB%	1.7	1.6	1.8	1.6	1.6		1.6	1.7	1.6	1.7
BOQ	9.3	13.5	5.7	13.3	14.0		12.7	6.1	14.0	9.1
QSRatio										
95th Percentile Output:										
fB%	1.9	1.8	2.1	1.8	1.8		1.8	2.1	1.8	1.9
BOQ	10.8	15.1	6.9	14.9	15.6		14.3	7.3	15.6	10.6
QSRatio										
98th Percentile Output:										
fB%	2.2	2.0	2.5	2.0	2.0		2.0	2.4	2.0	2.2
BOQ	12.3	16.7	8.0	16.5	17.2		15.9	8.5	17.2	12.1
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	53	171	504	239	525	10	286	145	124	21	532	123
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P	P			SB	Left	P	P
	Thru	P	P				Thru	P	P
	Right	P	P				Right	P	P
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0	10.0				13.0	14.0	9.0
Yellow		3.0	3.0				3.0	3.0	3.0
All Red		0.0	2.0				0.0	0.0	2.0

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	138	496	0.43	0.28	35.3	D		
TR	875	3149	0.88	0.28	41.8	D	41.4	D
Westbound								
DefL	378	1770	0.77	0.42	45.7	D		
TR	784	1858	0.83	0.42	32.5	C	36.6	D
Northbound								
DefL	387	1847	0.80	0.29	48.1	D		
TR	523	1810	0.55	0.29	31.2	C	39.9	D
Southbound								
L	367	1652	0.06	0.33	20.8	C		
TR	1053	3159	0.66	0.33	28.9	C	28.7	C

Intersection Delay = 36.7 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	53	171	504	239	525	10	286	145	124	21	532	123
% Heavy Veh	2	2	2	2	2	2	1	1	1	2	2	2
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
PK 15 Vol	15	49	143	73	160	3	77	39	33	6	141	33
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		1900	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	60	767		291	652		308	289		22	697	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.747			0.018			0.460			0.188	
Peds Bikes	0	0		0	0		0	0		0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0		0.0	0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.884			0.927			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds	X	X
WB	Left	P	P			SB	Left	P	P
	Thru	P	P				Thru	P	P
	Right	P	P				Right	P	P
	Peds		X				Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0	10.0					13.0	14.0
Yellow		3.0	3.0					3.0	3.0
All Red		0.0	2.0					0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	53	171	504	239	525	10	286	145	124	21	532	123
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.94	0.94	0.94
Adj flow	60	194	573	291	640	12	308	156	133	22	566	131
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	60	767		291	652		308	289		22	697	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.747			0.018			0.460			0.188	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		1900	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.967	1.000		1.000	1.000		1.033	1.033		0.933	0.917	
fHV	0.980	0.980		0.980	0.980		0.990	0.990		0.980	0.980	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.888			0.997			0.931			0.972	
fLT	0.275	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.				0.174			0.387			0.391		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	496	3149		1770	1858		1847	1810		1652	3159	
Sec.				324			753			680		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	60	496	0.12	0.28	138	0.43
Prot							
Perm							
Thru	TR	767	3149	0.24	0.28	875	0.88
Right							
Westbound							
Prot		208	1770	0.12	0.167	295	0.71
Perm		83	324	# 0.26	0.256	83	1.00
Left	DefL	291			0.42	378	0.77
Prot							
Perm							
Thru	TR	652	1858	# 0.35	0.42	784	0.83
Right							
Northbound							
Prot		208	1847	0.11	0.156	287	0.72
Perm		100	753	0.13	0.133	100	1.00
Left	DefL	308			0.29	387	0.80
Prot							
Perm							
Thru	TR	289	1810	# 0.16	0.29	523	0.55
Right							
Southbound							
Prot		22	1652	0.01	0.144	239	0.09
Perm		0	680	0.00	0.189	128	0.00
Left	L	22			0.33	367	0.06
Prot							
Perm							
Thru	TR	697	3159	# 0.22	0.33	1053	0.66
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.99
Total lost time per cycle, L = 18.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.23

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.43	0.28	26.7	1.000	138	0.50	8.6	0.0	35.3	D			
TR	0.88	0.28	31.0	1.000	875	0.50	10.8	0.0	41.8	D	41.4	D	
Westbound													
DefL	0.77	0.42	32.6	1.000	378	0.50	13.1	0.0	45.7	D			
TR	0.83	0.42	23.2	1.000	784	0.50	9.4	0.0	32.5	C	36.6	D	
Northbound													
DefL	0.80	0.29	32.6	1.000	387	0.50	15.5	0.0	48.1	D			
TR	0.55	0.29	27.1	1.000	523	0.50	4.2	0.0	31.2	C	39.9	D	
Southbound													
L	0.06	0.33	20.4	1.000	367	0.50	0.3	0.0	20.8	C			
TR	0.66	0.33	25.7	1.000	1053	0.50	3.3	0.0	28.9	C	28.7	C	

Intersection delay = 36.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

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for exclusive lefts

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Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)	25.0	38.0	26.0	30.0
Effective permitted green time for LT lane group, g(s)	25.0	23.0	12.0	17.0
Opposing effective green time, go (s)	38.0	25.0	30.0	26.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	60	291	308	22
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	652	767	697	289
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00
Computation				
LT volume per cycle, LTC=VLTC/3600	1.50	7.28	7.70	0.55
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.15	10.07	9.15	3.61
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.58	0.72	0.67	0.71
gq, (see Exhibit C16-4,5,6,7,8)	8.50	13.74	0.00	5.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.50	9.26	12.00	11.41
n=Max(gq-gf)/2,0)	4.25	6.87	0.00	2.79
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.40	2.77	2.58	1.72
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.16	0.17	0.33	0.24
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.28	0.17	0.39	0.39
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.275	0.174	0.387	0.391

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

**** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.**

For special case of multilane approach opposed by single-lane approach
or when $q_f > q_g$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdif = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdif / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		25.0		14.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Pedestrian flow rate, Vpedg (p/h)		0		0
OCCpedg		0.000		0.000
Opposing queue clearing green, gq (s)		13.74		5.59
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.550		0.399
OCCpedu		0.000		0.000
Opposing flow rate, Vo (veh/h)		767		289
OCCr		0.000		0.000
Number of cross-street receiving lanes, Nrec		2		2
Number of turning lanes, Nturn		1		1
ApbT		1.000		1.000
Proportion of left turns, PLT		1.000		1.000
Proportion of left turns using protected phase, PLTA		0.000		0.000
Left-turn adjustment, fLpb		1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	25.0	10.0	26.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	25.0	23.0	26.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.747	0.018	0.460
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	291	308	22	
v/c ratio from Capacity Worksheet, X	0.77	0.80	0.06	
Protected phase effective green interval, g (s)	15.0	14.0	13.0	
Opposing queue effective green interval, gq	13.74	0.00	5.59	
Unopposed green interval, gu	9.26	12.00	11.41	
Red time r=(C-g-gq-gu)	52.0	64.0	60.0	
Arrival rate, qa=v/(3600(max[X,1.0]))	0.08	0.09	0.01	
Protected ph. departure rate, Sp=s/3600	0.492	0.513	0.459	
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.22	0.21	0.28	
XPerm	2.93	2.59	0.03	
XProt			0.07	
Case	5	5	1	
Queue at beginning of green arrow, Qa	3.99	3.99	0.37	
Queue at beginning of unsaturated green, Qu	5.31	5.48	0.03	
Residual queue, Qr	0.00	0.00	0.00	
Uniform Delay, d1	32.6	32.6	20.4	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	32.5	26.7	0.00	0.0	0.0	35.3
TR	0.0	0.00	32.5	31.0	0.00	0.0	0.0	41.8
	0.0						0.0	
Westbound								
DefL	0.0	0.00		32.6	0.00	0.0	0.0	45.7
TR	0.0	0.00	26.0	23.2	0.00	0.0	0.0	32.5
	0.0						0.0	
Northbound								
DefL	0.0	0.00		32.6	0.00	0.0	0.0	48.1
TR	0.0	0.00	32.0	27.1	0.00	0.0	0.0	31.2
	0.0						0.0	
Southbound								
L	0.0	0.00		20.4	0.00	0.0	0.0	20.8
TR	0.0	0.00	30.0	25.7	0.00	0.0	0.0	28.9
	0.0						0.0	
Intersection Delay			36.7	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	60	402		291	652		308	289		22	366	
So	1900	1900		1900	1900		1900	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	496	1653		895	1858		1342	1810		1101	1659	
LnCapacity	138	459		378	784		387	523		367	553	
Flow Ratio	0.1	0.2		0.3	0.4		0.2	0.2		0.0	0.2	
v/c Ratio	0.43	0.88		0.77	0.83		0.80	0.55		0.06	0.66	
Grn Ratio	0.28	0.28		0.42	0.42		0.29	0.29		0.33	0.33	
I Factor		0.884			0.927			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	1.2	9.6		4.8	14.5		6.2	6.1		0.4	7.8	
kB	0.3	0.6		0.5	0.9		0.6	0.7		0.6	0.8	
Q2	0.2	2.9		1.6	3.6		1.9	0.9		0.0	1.4	
Q Average	1.4	12.5		6.4	18.1		8.2	7.0		0.4	9.2	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	1.8	15.1		7.8	21.8		10.0	8.6		0.5	11.2	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.5	1.4		1.5	1.5		1.7	1.4	
BOQ	2.3	17.8		9.5	25.5		11.9	10.3		0.7	13.3	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.5		1.6	1.5		1.6	1.6		2.0	1.6	
BOQ	2.7	19.3		10.5	27.4		13.1	11.3		0.8	14.6	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.7		1.9	1.6		1.8	1.8		2.5	1.8	
BOQ	3.3	21.1		12.0	29.5		14.7	12.9		1.0	16.2	
QSRatio												
98th Percentile Output:												
fB%	2.8	1.8		2.1	1.7		2.0	2.1		3.1	1.9	
BOQ	4.0	22.8		13.5	31.6		16.3	14.5		1.3	17.9	
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 6 < minimum green time for peds.
WARNING: Phase 7 < minimum green time for peds.

Analyst: ML	Inter.: Boscombe Ave & OBX Off-Ramp
Agency: AECOM	Area Type: All other areas
Date: 08/29/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Period	Year : 2020 FULL Mitigation Alt. 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Outerbridge Crossing Off-Ramp

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Volume	761	395	4	3	404	868	2	3	2	151	0	288
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		35.0	24.0					16.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

L	759	1728	1.11	0.71	86.3	F			
TR	1169	1644	0.38	0.71	5.8	A	58.6	E	

LT	500	1876	0.86	0.27	43.1	D	14.4	B
R	1599	1599	0.57	1.00	1.0	A		

LTR	185	1043	0.09	0.18	31.9	C	31.9	C
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L	233	1310	0.81	0.18	61.1	E			
LT	323	1818	0.00	0.18	30.4	C	27.4	C	
R	928	1492	0.39	0.62	9.7	A			

Intersection Delay = 34.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	761	395	4	3	404	868	2	3	2	151	0	288
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.44	0.44	0.44	0.80	0.80	0.80
PK 15 Vol	211	110	1	1	106	228	1	2	1	47	0	90
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900	1900		1900		1900	1900	1900
ParkExist			X									
NumPark			5									
No. Lanes	1	1	0	0	1	1	0	1	0	1	1	1
LGConfig	L	TR			LT	R		LTR		L	LT	R
Lane Width	11.0	12.0			12.0	12.0		16.0		10.0	11.0	10.0
RTOR Vol			0			0			0			0
Adj Flow	846	443			428	914		17		189	0	360
%InSharedLn										0		
Prop LTS	1.000	0.000			0.007			0.294		1.000	0.000	
Prop RTS		0.009			0.000	1.000		0.294			0.000	1.000
Peds Bikes	0	0	0	0			0			0		
Buses	0	0		0	0		0			0	0	0
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	0.0
Arriv. Type	3	3		3	3		3			3	3	3
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	3.0
I Factor		0.687		0.650			1.000			1.000		
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	2.0
Ped Min g		14.6		24.6			20.9			20.1		

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds		
WB	Left		P			SB	Left	P	
	Thru		P				Thru	P	
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		35.0	24.0				16.0		
Yellow		3.0	3.0				3.0		
All Red		2.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	761	395	4		3	404	868		2	3	2		151	0	288
PHF	0.90	0.90	0.90		0.95	0.95	0.95		0.44	0.44	0.44		0.80	0.80	0.80
Adj flow	846	439	4		3	425	914		5	7	5		189	0	360
No. Lanes	1	1	0		0	1	1		0	1	0		1	1	1
Lane group	L	TR				LT	R			LTR			L	LT	R
Adj flow	846	443				428	914			17			189	0	360
Prop LTs	1.000	0.000				0.007				0.294			1.000	0.000	
Prop RTs		0.009				0.000	1.000			0.294				0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	TR			LT	R			LTR				L	LT	R
So	1900	1900			1900	1900			1900				1900	1900	1900
Lanes	1	1	0	0	1	1	0		1	0			1	1	1
fW	0.967	1.000			1.000	1.000			1.133				0.933	0.967	0.933
fHV	0.990	0.990			0.990	0.990			0.990				0.990	0.990	0.990
fG	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fP	1.000	0.875			1.000	1.000			1.000				1.000	1.000	1.000
fBB	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fA	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fLU	1.000	1.000			1.000	1.000			1.000				1.000	1.000	1.000
fRT		0.999			1.000	0.850			0.960					1.000	0.850
fLT	0.950	1.000			0.997				0.509				0.746	1.000	
Sec.	0.149														
fLpb	1.000	1.000			1.000				1.000				1.000	1.000	
fRpb		1.000			1.000	1.000			1.000					1.000	1.000
S	1728	1644			1876	1599			1043				1310	1818	1492
Sec.	271														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	-- v/c Ratio
Eastbound							
Prot		672	1728	# 0.39	0.389	672	1.00
Perm		174	271	# 0.64	0.322	87	2.00
Left	L	846			0.71	759	1.11
Prot							
Perm							
Thru	TR	443	1644	0.27	0.71	1169	0.38
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	428	1876	0.23	0.27	500	0.86
Right	R	914	1599	0.57	1.00	1599	0.57
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	17	1043	0.02	0.18	185	0.09
Right							
Southbound							
Prot							
Perm							
Left	L	189	1310	# 0.14	0.18	233	0.81
Prot							
Perm							
Thru	LT	0	1818	0.00	0.18	323	0.00
Right	R	360	1492	0.24	0.62	928	0.39

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.18
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.32

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.11	0.71	22.0	1.000	759	0.50	64.3	0.0	86.3	F			
TR	0.38	0.71	5.1	1.000	1169	0.50	0.6	0.0	5.8	A	58.6	E	
Westbound													
LT	0.86	0.27	31.4	1.000	500	0.50	11.8	0.0	43.1	D	14.4	B	
R	0.57	1.00	0.0	0.950	1599	0.50	1.0	0.0	1.0	A			
Northbound													
LTR	0.09	0.18	30.9	1.000	185	0.50	1.0	0.0	31.9	C	31.9	C	
Southbound													
L	0.81	0.18	35.5	1.000	233	0.50	25.5	0.0	61.1	E			
LT	0.00	0.18	30.4	1.000	323	0.50	0.0	0.0	30.4	C	27.4	C	

R 0.39 0.62 8.5 1.000 928 0.50 1.2 0.0 9.7 A

Intersection delay = 34.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	64.0			16.0
Effective permitted green time for LT lane group, g(s)	29.0			16.0
Opposing effective green time, go (s)	24.0			16.0
Number of lanes in LT lane group, N	1			1
Number of lanes in opposing approach, No	1			1
Adjusted LT flow rate, VLT (veh/h)	846			189
Proportion of LT in LT lane group, PLT	1.000			1.000
Proportion of LT in opposing flow, PLTo	0.01			0.29
Adjusted opposing flow rate, Vo (veh/h)	428			17
Lost time for LT lane group, tL	5.00			5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	21.15			4.72
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.70			0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73			0.82
gq, (see Exhibit C16-4,5,6,7,8)	20.59			0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.41			16.00
n=Max(gq-gf)/2,0)	10.29			0.00
PTHo=1-PLTo	0.99			0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			1.00
EL1 (refer to Exhibit C16-3)	1.95			1.34
EL2=Max((1-Ptho**n)/Plto, 1.0)	9.97			1.00
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14			0.25
gdifff=max(gq-gf,0)	20.59			0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.15			0.75
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.149			0.746

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		24.0	16.0	16.0
Effective permitted green time for LT lane group, g(s)		24.0	16.0	16.0
Opposing effective green time, go (s)		64.0	16.0	16.0
Number of lanes in LT lane group, N		1	1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	5	0
Proportion of LT in LT lane group, PLT	0.000	0.007	0.294
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.29
Adjusted opposing flow rate, Vo (veh/h)	443	0	17
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.08	0.13	0.00
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	11.07	0.00	0.43
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	15.9	8.1	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.29	0.82	0.82
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	8.09	7.88	16.00
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	1.00	0.71
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.01	0.29	0.00
EL1 (refer to Exhibit C16-3)	2.17	800.00	
EL2=Max((1-Ptho**n)/Plto, 1.0)			1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.08	0.16	0.13
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.51	1.00
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.997	0.509	1.000

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)		24.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Pedestrian flow rate, Vpedg (p/h)		0		
OCCpedg		0.000		
Opposing queue clearing green, gq (s)		0.00		
Eff. ped. green consumed by opp. veh. queue, gq/gp		0.000		
OCCpedu		0.000		
Opposing flow rate, Vo (veh/h)		443		
OCCr		0.000		
Number of cross-street receiving lanes, Nrec		1		
Number of turning lanes, Nturn		1		
ApbT		1.000		
Proportion of left turns, PLT		0.007		
Proportion of left turns using protected phase, PLTA		0.000		
Left-turn adjustment, fLpb		1.000		

Permitted Right Turns

Effective pedestrian green time, gp (s)	64.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	64.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.009
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	846			
v/c ratio from Capacity Worksheet, X	1.11			
Protected phase effective green interval, g (s)	35.0			
Opposing queue effective green interval, gq	20.59			
Unopposed green interval, gu	8.41			
Red time r=(C-g-gq-gu)	26.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.21			
Protected ph. departure rate, Sp=s/3600	0.480			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.26			
XPerm	2.80			
XProt	0.77			
Case	3			
Queue at beginning of green arrow, Qa	9.41			
Queue at beginning of unsaturated green, Qu	4.34			
Residual queue, Qr	3.93			
Uniform Delay, d1	22.0			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		22.0	0.00	21.7	0.0	86.3
TR	0.0	0.00	13.0	5.1	0.00	0.0	0.0	5.8
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	33.0	31.4	0.00	0.0	0.0	43.1
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	1.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	37.0	30.9	0.00	0.0	0.0	31.9
	0.0						0.0	
Southbound								
L	0.0	0.00	37.0	35.5	0.00	0.0	0.0	61.1
LT	0.0	0.00	37.0	30.4	0.00	0.0	0.0	30.4
R	0.0	0.00	17.0	8.5	0.00	0.0	0.0	9.7

Intersection Delay	34.6	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	L	TR		LT	R	L	TR	L	LT	R
Init Queue	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0
Flow Rate	846	443		428	914	17		189	0	360
So	1900	1900		1900	1900	1900		1900	1900	1900
No.Lanes	1	1	0	1	1	0	1	1	1	
SL	1068	1644		1876	1599	1043		1310	1818	1492
LnCapacity	759	1169		500	1599	185		233	323	928
Flow Ratio	0.8	0.3		0.2	0.6	0.0		0.1	0.0	0.2
v/c Ratio	1.11	0.38		0.86	0.57	0.09		0.81	0.00	0.39
Grn Ratio	0.71	0.71		0.27	1.00	0.18		0.18	0.18	0.62
I Factor		0.687		0.650		1.000			1.000	
AT or PVG	3	3		3	3	3		3	3	3
Pltn Ratio	1.00	1.00		1.00	1.00	1.00		1.00	1.00	1.00
PF2	1.00	1.00		1.00		1.00		1.00	1.00	1.00
Q1	10.0	4.4		10.2		0.4		4.5	0.0	4.5
kB	0.6	0.9		0.5	1.0	0.4		0.4	0.5	1.1
Q2	15.3	0.5		2.2	1.4	0.0		1.4	0.0	0.7
Q Average	25.3	4.9		12.4		0.4		5.9	0.0	5.2
Q Spacing	25.0	25.0		25.0	25.0	25.0		25.0	25.0	25.0
Q Storage	0	0		0	0	0		0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.2	1.2		1.2		1.3		1.2	1.3	1.2
BOQ	30.4	6.1		14.9		0.5		7.3	0.0	6.4
QSRatio										
85th Percentile Output:										
fB%	1.4	1.5		1.4		1.7		1.5	1.7	1.5
BOQ	35.5	7.4		17.6		0.7		8.9	0.0	7.8
QSRatio										
90th Percentile Output:										
fB%	1.5	1.7		1.5		2.0		1.7	2.0	1.7
BOQ	38.1	8.3		19.1		0.8		9.8	0.0	8.7
QSRatio										
95th Percentile Output:										
fB%	1.6	2.0		1.7		2.5		1.9	2.6	2.0
BOQ	40.7	9.7		20.8		1.0		11.3	0.0	10.1
QSRatio										
98th Percentile Output:										
fB%	1.7	2.3		1.8		3.1		2.2	3.2	2.2
BOQ	43.3	11.1		22.6		1.2		12.8	0.0	11.5
QSRatio										

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/22/2013	Jurisd: Staten Island, NY
Period: Weekday 5-6 PM Peak Hour	Year : 2020 Miti-Action Alt 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	514	36	0	1	36	43	3	3	2	62	1	1236
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			10			0			294

Phase Combination		1	2	3	4		5	6	7	8
EB	Left	P	P			NB	Left	P		
	Thru	P	P				Thru	P		
	Right	P	P				Right	P		
	Peds	X	X				Peds	X		
WB	Left	P				SB	Left	P		
	Thru	P					Thru	P		
	Right	P					Right	P		
	Peds	X					Peds	X		
NB	Right					EB	Right			
SB	Right		P			WB	Right			
Green		31.0	11.0					35.0		
Yellow		3.0	3.0					3.0		
All Red		0.0	2.0					2.0		

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	845	2025	0.68	0.50	22.2	C		
TR	1066	2132	0.04	0.50	11.5	B	21.5	C

LTR	1075	3122	0.07	0.34	19.9	B	19.9	B
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LTR	1220	3136	0.01	0.39	16.9	B	16.9	B
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LT	548	1410	0.12	0.39	18.1	B	82.0	F
R	897	1583	1.12	0.57	86.3	F		

Intersection Delay = 58.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 5-6 PM Peak Hour
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	514	36	0	1	36	43	3	3	2	62	1	1236	
% Heavy Veh	1	1	1	1	1	1	1	1	1	2	2	2	
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94	
PK 15 Vol	143	10	0	1	9	11	2	2	1	16	1	329	
Hi Ln Vol													
% Grade		0			0			0			0		
Ideal Sat	1900	1900			1900			1900			1900	1900	
ParkExist													
NumPark													
No. Lanes		0	2	0		0	2	0			0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R	
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0	
RTOR Vol			0			10			0			294	
Adj Flow	571	40			74			16			67	1002	
%InSharedLn													
Prop LTs	1.000	0.000			0.014			0.375			0.985		
Prop RTs		0.000			0.473			0.250			0.000	1.000	
Peds Bikes		0	0		0	0		0	0		0	0	
Buses	0	0			0			0			0	0	
%InProtPhase	0.0											0.0	
Duration	0.25			Area Type: All other areas									

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.952			1.000			1.000			0.937	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		31.0	11.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	514	36	0	1	36	43	3	3	2	62	1	1236
PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.50	0.50	0.50	0.94	0.94	0.94
Adj flow	571	40	0	1	38	35	6	6	4	66	1	1002
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	571	40			74			16			67	1002
Prop LTs	1.000	0.000			0.014			0.375			0.985	
Prop RTs		0.000			0.473			0.250			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	DefL	TR	LTR		LTR		LT	R
So	1900	1900	1900		1900		1900	1900
Lanes	0	2	0	0	2	0	0	1
fW	1.133	1.133	0.983		1.000		1.000	1.000
fHV	0.990	0.990	0.990		0.990		0.980	0.980
fG	1.000	1.000	1.000		1.000		1.000	1.000
fP	1.000	1.000	1.000		1.000		1.000	1.000
fBB	1.000	1.000	1.000		1.000		1.000	1.000
fA	1.000	1.000	1.000		1.000		1.000	1.000
fLU	1.000	1.000	0.952		0.952		1.000	1.000
fRT		1.000	0.929		0.962		1.000	0.850
fLT	0.950	1.000	0.954		0.910		0.757	
Sec.	0.706							
fLpb	1.000	1.000	1.000		1.000		1.000	
fRpb		1.000	1.000		1.000		1.000	1.000
S	2025	2132	3122		3136		1410	1583
Sec.	1506							

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	86	2025	0.04	0.178	360	0.24
Perm		485	1506	# 0.32	0.322	485	1.00
Left		571			0.50	845	0.68
Prot	TR	40	2132	0.02	0.50	1066	0.04
Perm							
Thru							
Right	LTR	74	3122	0.02	0.34	1075	0.07
Prot							
Perm							
Left	LTR	16	3136	0.01	0.39	1220	0.01
Prot							
Perm							
Thru	LT	67	1410	0.05	0.39	548	0.12
Right							
Prot	R	1002	1583	# 0.63	0.57	897	1.12
Perm							
Left							
Prot	LT	67	1410	0.05	0.39	548	0.12
Perm							
Thru							
Right	R	1002	1583	# 0.63	0.57	897	1.12

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.96
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.68	0.50	18.1	1.000	845	0.50	4.1	0.0	22.2	C			
TR	0.04	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.5	B	21.5	C	
Westbound													
LTR	0.07	0.34	19.8	1.000	1075	0.50	0.1	0.0	19.9	B	19.9	B	
Northbound													
LTR	0.01	0.39	16.9	1.000	1220	0.50	0.0	0.0	16.9	B	16.9	B	
Southbound													
LT	0.12	0.39	17.6	1.000	548	0.50	0.4	0.0	18.1	B	82.0	F	

R 1.12 0.57 19.5 1.000 897 0.50 66.8 0.0 86.3 F

Intersection delay = 58.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	29.0			
Opposing effective green time, go (s)	31.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	571			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.01			
Adjusted opposing flow rate, Vo (veh/h)	74			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/3600	14.28			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.97			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	29.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	0.99			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.42			
EL2=Max((1-Ptho*n)/Plto, 1.0)	1.00			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.71			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.706			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		31.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		31.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2	
Adjusted LT flow rate, VLT (veh/h)	1	6	66	
Proportion of LT in LT lane group, PLT	0.000	0.014	0.375	0.985
Proportion of LT in opposing flow, PLTo	0.00	0.99	0.38	
Adjusted opposing flow rate, Vo (veh/h)	40	67	16	
Lost time for LT lane group, tL	3.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.03	0.15	1.65	
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	1.67	0.21	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	26.1	22.9	4.9	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.88	12.09	30.10	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	1.00	0.01	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.03	0.75	0.99	
EL1 (refer to Exhibit C16-3)	1.44	1.48	1.40	
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.10	0.11	
gdif=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	0.91	0.76	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.954	0.910	0.757	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	31.0	31.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	74	40	67	16
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.014	0.375	0.985
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	31.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	31.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.473	0.250	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	571			
v/c ratio from Capacity Worksheet, X	0.68			
Protected phase effective green interval, g (s)	16.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	29.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.16			
Protected ph. departure rate, Sp=s/3600	0.563			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.42			
XPerm	0.97			
XProt				
Case	4			
Queue at beginning of green arrow, Qa	0.00			
Queue at beginning of unsaturated green, Qu	7.14			
Residual queue, Qr	0.00			
Uniform Delay, d1	18.1			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand	Dur. Unmet Demand	Uniform Delay		Initial Queue	Final Unmet	Initial	Lane
	Q veh	t hrs.	Unadj. ds	Adj. d1 sec	Param. u	Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
DefL	0.0	0.00		18.1	0.00	0.0	0.0	22.2
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	29.5	19.8	0.00	0.0	0.0	19.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.9	0.00	0.0	0.0	16.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	17.6	0.00	0.0	0.0	18.1
R	0.0	0.00	19.5	19.5	0.00	26.2	0.0	86.3
Intersection Delay			58.0	sec/veh	Intersection LOS E			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	571	40			38				8				67	1002	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1691	2132			1639				1647				1410	1583	
LnCapacity	845	1066			564				640				548	897	
Flow Ratio	0.3	0.0			0.0				0.0				0.0	0.6	
v/c Ratio	0.68	0.04			0.07				0.01				0.12	1.12	
Grn Ratio	0.50	0.50			0.34				0.39				0.39	0.57	
I Factor		0.952			1.000				1.000				0.937		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	8.1	0.5			0.6				0.1				1.1	25.0	
kB	1.0	1.1			0.8				0.8				0.7	1.0	
Q2	1.9	0.0			0.1				0.0				0.1	19.5	
Q Average	10.0	0.6			0.7				0.1				1.2	44.5	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	12.2	0.7			0.9				0.2				1.5	53.5	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.7				1.7				1.6	1.4	
BOQ	14.4	0.9			1.2				0.2				1.9	62.4	
QSRatio															
90th Percentile Output:															
fB%	1.6	1.9			1.9				2.0				1.9	1.5	
BOQ	15.7	1.1			1.3				0.3				2.2	66.8	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.5				2.6				2.4	1.6	
BOQ	17.4	1.4			1.7				0.3				2.8	71.3	
QSRatio															
98th Percentile Output:															
fB%	1.9	3.0			3.0				3.2				2.9	1.7	
BOQ	19.1	1.7			2.1				0.4				3.4	75.7	
QSRatio															

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/13
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Englewood Avenue

Inter.: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	192	268	158	8	60	9	460	105	2			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		22.0					28.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	587	1602	0.92	0.37	40.3	D	35.4	D
R	586	1599	0.21	0.37	13.9	B		

Westbound

LTR	553	1508	0.16	0.37	13.4	B	13.4	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	2220	4758	0.29	0.47	10.2	B	10.2	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 22.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	192	268	158	8	60	9	460	105	2			
% Heavy Veh	1	1	1	1	1	1	1	1	1			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
PK 15 Vol	56	79	46	2	17	3	129	29	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			53			0			0			
Adj Flow		541	124		88			637				
%InSharedLn												
Prop LTs		0.418			0.102			0.812				
Prop RTs		0.000	1.000		0.114			0.003				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.999			0.996			0.980				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left		
	Thru	P						Thru		
	Right	P						Right		
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		22.0						28.0		
Yellow		3.0						3.0		
All Red		2.0						2.0		

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	192	268	158	8	60	9	460	105	2			
PHF	0.85	0.85	0.85	0.87	0.87	0.87	0.89	0.89	0.89			
Adj flow	226	315	124	9	69	10	517	118	2			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow		541	124		88			637				
Prop LTs		0.418			0.102			0.812				
Prop RTs	0.000	1.000		0.114			0.003					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		0.990			0.990	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.985			1.000	
fLT	0.824			0.946			0.961	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1602	1599		1508			4758	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	541	1602	# 0.34	0.37	587	0.92
Right	R	124	1599	0.08	0.37	586	0.21
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	88	1508	0.06	0.37	553	0.16
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	637	4758	# 0.13	0.47	2220	0.29
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
LT	0.92	0.37	18.2	1.000	587	0.50	22.1	0.0	40.3	D	35.4	D
R	0.21	0.37	13.0	1.000	586	0.50	0.8	0.0	13.9	B		
Westbound												
LTR	0.16	0.37	12.8	1.000	553	0.50	0.6	0.0	13.4	B	13.4	B
Northbound												
LTR	0.29	0.47	9.9	1.000	2220	0.50	0.3	0.0	10.2	B	10.2	B
Southbound												

Intersection delay = 22.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	22.0	22.0		
Effective permitted green time for LT lane group, g(s)	22.0	22.0		
Opposing effective green time, go (s)	22.0	22.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	226	9	
Proportion of LT in LT lane group, PLT	0.418	0.102	0.812
Proportion of LT in opposing flow, PLTo	0.10	0.42	
Adjusted opposing flow rate, Vo (veh/h)	88	541	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	3.77	0.15	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.47	9.02	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	12.5	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.63	0.63	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	11.27	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.00	9.46	
n=Max(gq-gf)/2,0)	0.00	0.00	
PTHo=1-PLTo	0.90	0.58	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.42	0.10	
EL1 (refer to Exhibit C16-3)	1.51	2.39	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.13	0.10	
gdifff=max(gq-gf,0)	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.82	0.95	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.824	0.946	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	22.0	22.0	28.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	11.27		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.512		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	88	541	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.418	0.102	0.812	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	22.0	22.0	28.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	22.0	22.0	28.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.114	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	19.0	18.2	0.00	0.0	0.0	40.3
R	0.0	0.00	19.0	13.0	0.00	0.0	0.0	13.9
Westbound								
	0.0						0.0	
LTR	0.0	0.00	19.0	12.8	0.00	0.0	0.0	13.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	16.0	9.9	0.00	0.0	0.0	10.2
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			22.4	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound	Southbound		
LaneGroup	LT	R	LTR	LTR			
Init Queue	0.0	0.0	0.0	0.0			
Flow Rate	541	124	88	233			
So	1900	1900	1900	1900			
No.Lanes	0 1	1	0 1	0 3	0 0	0	
SL	1602	1599	1508	1746			
LnCapacity	587	586	553	814			
Flow Ratio	0.3	0.1	0.1	0.1			
v/c Ratio	0.92	0.21	0.16	0.29			
Grn Ratio	0.37	0.37	0.37	0.47			
I Factor	0.999		0.996	0.980			
AT or PVG	3	3	3	3			
Pltn Ratio	1.00	1.00	1.00	1.00			
PF2	1.00	1.00	1.00	1.00			
Q1	8.6	1.4	1.0	2.4			
kB	0.6	0.6	0.6	0.7			
Q2	4.1	0.2	0.1	0.3			
Q Average	12.7	1.6	1.1	2.7			
Q Spacing	25.0	25.0	25.0	25.0			
Q Storage	0	0	0	0			
Q S Ratio							
70th Percentile Output:							
fB%	1.2	1.3	1.3	1.3			
BOQ	15.3	2.0	1.4	3.4			
QSRatio							
85th Percentile Output:							
fB%	1.4	1.6	1.6	1.6			
BOQ	18.1	2.6	1.8	4.2			
QSRatio							
90th Percentile Output:							
fB%	1.5	1.9	1.9	1.8			
BOQ	19.6	2.9	2.1	4.8			
QSRatio							
95th Percentile Output:							
fB%	1.7	2.3	2.4	2.2			
BOQ	21.3	3.7	2.6	5.9			
QSRatio							
98th Percentile Output:							
fB%	1.8	2.8	2.9	2.6			
BOQ	23.1	4.4	3.2	6.9			
QSRatio							

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/22/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	4		161	282	463	274	99	206		499	5	
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0					0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left	P	P			SB Left			
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds	X	X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	8.0	14.0				23.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	120	878	0.03	0.13	23.1	C	44.0	D
R	220	1652	0.77	0.13	44.5	D		
Westbound								
LTR	2110	4689	0.55	0.45	12.6	B	12.6	B
Northbound								
L	157	409	0.69	0.38	36.0	D		
T	708	1848	0.32	0.38	14.1	B	21.2	C
Southbound								
TR	770	2010	0.75	0.38	21.9	C	21.9	C

Intersection Delay = 18.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	4		161	282	463	274	99	206		499	5	
% Heavy Veh	1		1	1	1	1	2	2		4	4	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
PK 15 Vol	1		42	80	132	78	27	56		143	2	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	4		169		1157		108	224			580	
%InSharedLn												
Prop LTs	1.000				0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	2			7	
%InProtPhase				0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.848			0.500			0.930			0.865	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left	P	P			SB	Left		
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		8.0	14.0					23.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	4		161	282	463	274	99	206		499	5	
PHF	0.95		0.95	0.88	0.88	0.88	0.92	0.92		0.87	0.87	
Adj flow	4		169	320	526	311	108	224		574	6	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L		T		TR	
Adj flow	4		169		1157		108	224			580	
Prop LTs	1.000				0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.269			0.000			0.010	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound		Westbound		Northbound		Southbound	
	L	R	L	R	L	T	L	T
So	1900	1900	1900		1900	1900	1900	
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967		1.000	1.000	1.133	
fHV	0.990	0.990	0.990		0.980	0.980	0.962	
fG	1.000	1.000	1.000		1.000	1.000	1.000	
fP	1.000	1.000	1.000		1.000	1.000	1.000	
fBB	1.000	1.000	1.000		1.000	0.992	0.972	
fA	1.000	1.000	1.000		1.000	1.000	1.000	
fLU	1.000	1.000	0.908		1.000	1.000	1.000	
fRT		0.850	0.960			1.000	0.999	
fLT	0.500		0.986		0.220	1.000	1.000	
Sec.								
fLpb	1.000		1.000		1.000	1.000	1.000	
fRpb		1.000	1.000			1.000	1.000	
S	878	1652	4689		409	1848	2010	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	4	878	0.00	0.13	120	0.03
Prot							
Perm							
Thru							
Right	R	169	1652	0.10	0.13	220	0.77
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1157	4689	# 0.25	0.45	2110	0.55
Right							
Northbound							
Prot							
Perm							
Left	L	108	409	0.26	0.38	157	0.69
Prot							
Perm							
Thru	T	224	1848	0.12	0.38	708	0.32
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	580	2010	# 0.29	0.38	770	0.75
Right							

Sum of flow ratios for critical lane groups, Yc =
Sum (v/s) = 0.54

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.64

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.03	0.13	22.6	1.000	120	0.50	0.4	0.0	23.1	C	44.0	D	
R	0.77	0.13	25.1	1.000	220	0.50	19.4	0.0	44.5	D			
Westbound													
LTR	0.55	0.45	12.0	1.000	2110	0.50	0.5	0.0	12.6	B	12.6	B	
Northbound													
L	0.69	0.38	15.5	1.000	157	0.50	20.5	0.0	36.0	D	21.2	C	
T	0.32	0.38	13.0	1.000	708	0.50	1.1	0.0	14.1	B			
Southbound													
TR	0.75	0.38	16.0	1.000	770	0.50	5.9	0.0	21.9	C	21.9	C	

Intersection delay = 18.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	8.0		23.0	
Effective permitted green time for LT lane group, g(s)	8.0		23.0	
Opposing effective green time, go (s)	27.0		23.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	3		1	
Adjusted LT flow rate, VLT (veh/h)	4		108	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.28		0.00	
Adjusted opposing flow rate, Vo (veh/h)	1157		580	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.07		1.80	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.08		9.67	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.55		0.62	
gq, (see Exhibit C16-4,5,6,7,8)	5.19		11.67	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	2.81		11.33	
n=Max(gq-gf)/2,0)	2.60		5.84	
PTHo=1-PLTo	0.72		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	4.31		2.24	
EL2=Max((1-Ptho**n)/Plto, 1.0)	2.06			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.50		0.17	
gdifff=max(gq-gf,0)	5.19		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.50		0.22	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.500		0.220	

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	8.0		23.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.19		11.67	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.649		0.508	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	1157		580	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		3	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	1.000		1.000	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	27.0		23.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	27.0		23.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.269	0.010
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	26.0	22.6	0.00	0.0	0.0	23.1
	0.0						0.0	
R	0.0	0.00	26.0	25.1	0.00	0.0	0.0	44.5
Westbound								
	0.0						0.0	
LTR	0.0	0.00	16.5	12.0	0.00	0.0	0.0	12.6
	0.0						0.0	
Northbound								
L	0.0	0.00	18.5	15.5	0.00	0.0	0.0	36.0
T	0.0	0.00	18.5	13.0	0.00	0.0	0.0	14.1
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	18.5	16.0	0.00	0.0	0.0	21.9
	0.0						0.0	
Intersection Delay			18.7	sec/veh	Intersection LOS		B	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound	Northbound		Southbound
LaneGroup	L	R	LTR	L	T	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	4	169	424	108	224	580
So	1900	1900	1900	1900	1900	1900
No.Lanes	1 0	1 0	3 0	1 1 0	0	1 0
SL	878	1652	1721	409	1848	2010
LnCapacity	120	220	774	157	708	770
Flow Ratio	0.0	0.1	0.2	0.3	0.1	0.3
v/c Ratio	0.03	0.77	0.55	0.69	0.32	0.75
Grn Ratio	0.13	0.13	0.45	0.38	0.38	0.38
I Factor		0.848	0.500		0.930	0.865
AT or PVG	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1	2.7	5.2	1.5	2.6	8.4
kB	0.2	0.3	0.4	0.2	0.6	0.6
Q2	0.0	0.7	0.4	0.4	0.3	1.8
Q Average	0.1	3.5	5.6	2.0	2.9	10.1
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0
Q S Ratio						
70th Percentile Output:						
fB%	1.3	1.2	1.2	1.3	1.3	1.2
BOQ	0.1	4.3	6.9	2.5	3.7	12.3
QSRatio						
85th Percentile Output:						
fB%	1.7	1.5	1.5	1.6	1.6	1.4
BOQ	0.1	5.4	8.4	3.1	4.6	14.6
QSRatio						
90th Percentile Output:						
fB%	2.0	1.7	1.7	1.8	1.8	1.6
BOQ	0.1	6.1	9.3	3.6	5.2	15.9
QSRatio						
95th Percentile Output:						
fB%	2.6	2.1	1.9	2.3	2.2	1.7
BOQ	0.2	7.3	10.8	4.5	6.3	17.6
QSRatio						
98th Percentile Output:						
fB%	3.2	2.4	2.2	2.7	2.5	1.9
BOQ	0.2	8.5	12.2	5.3	7.4	19.2
QSRatio						

ERROR MESSAGES

WARNING: Phase 1 < minimum green time for peds.
WARNING: Phase 2 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/31/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L	T	R	LTR			LTR		
Volume	6	13	20	266	29	109	18	314	174	93	450	10
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 618 1426 0.09 0.43 15.3 B 15.3 B

Westbound

L 545 1257 0.56 0.43 22.9 C
 T 773 1783 0.04 0.43 14.8 B 20.6 C
 R 570 1316 0.22 0.43 16.8 B

Northbound

LTR 752 1650 0.73 0.46 24.2 C 24.2 C

Southbound

LTR 648 1422 0.98 0.46 36.9 D 36.9 D

Intersection Delay = 27.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	6	13	20	266	29	109	18	314	174	93	450	10
% Heavy Veh	2	2	2	3	3	3	1	1	1	2	2	2
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
PK 15 Vol	2	5	7	76	8	31	5	85	47	27	129	3
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900	1900	1900			1900		
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol			0			0			0			0
Adj Flow	57			306	33	125	550			635		
%InSharedLn												
Prop LTS		0.158		1.000	0.000			0.036			0.169	
Prop RTS	0.509			0.000	1.000		0.344			0.017		
Peds Bikes	50	0		0	0		50	0		0	0	
Buses	2			0	0	2	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0	0.0	0.0			0.0		
Arriv. Type	3			3	3	3	3			3		
Unit Ext.	3.0			3.0	3.0	3.0	3.0			3.0		
I Factor	1.000			0.905			0.663			0.229		
Lost Time	2.0			2.0	2.0	2.0	2.0			2.0		
Ext of g	2.0			2.0	2.0	2.0	2.0			2.0		
Ped Min g	11.5			11.8			18.9			18.3		

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		39.0							41.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	6	13	20	266	29	109	18	314	174	93	450	10
PHF	0.70	0.70	0.70	0.87	0.87	0.87	0.92	0.92	0.92	0.87	0.87	0.87
Adj flow	9	19	29	306	33	125	20	341	189	107	517	11
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L T R			LTR			LTR		
Adj flow	57			306 33 125			550			635		
Prop LTs	0.158			1.000 0.000			0.036			0.169		
Prop RTs	0.509			0.000 1.000			0.344			0.017		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound		
LG	LTR		L	T	R	LTR		LTR		
So	1900		1900	1900	1900	1900		1900		
Lanes 0	1	0	1	1	1	1	0	0	1	0
fW	1.000		1.000	0.967	0.967	0.967		1.000		
fHV	0.980		0.971	0.971	0.971	0.990		0.980		
fG	1.000		1.000	1.000	1.000	1.000		1.000		
fP	0.875		1.000	1.000	0.875	1.000		1.000		
fBB	0.992		1.000	1.000	0.992	1.000		1.000		
fA	1.000		1.000	1.000	1.000	1.000		1.000		
fLU	1.000		1.000	1.000	1.000	1.000		1.000		
fRT	0.931		1.000 0.850			0.954		0.998		
fLT	0.976		0.720	1.000		0.969		0.768		
Sec.										
fLpb	1.000		0.947	1.000		1.000		0.996		
fRpb	0.971		1.000 1.000			0.981		1.000		
S	1426		1257	1783	1316	1650		1422		
Sec.										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	57	1426	0.04	0.43	618	0.09
Right							
Westbound							
Prot							
Perm							
Left	L	306	1257	# 0.24	0.43	545	0.56
Prot							
Perm							
Thru	T	33	1783	0.02	0.43	773	0.04
Right	R	125	1316	0.09	0.43	570	0.22
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	550	1650	0.33	0.46	752	0.73
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	635	1422	# 0.45	0.46	648	0.98
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.69
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.09	0.43	15.1	1.000	618	0.50	0.3	0.0	15.3	B	15.3	B
Westbound												
L	0.56	0.43	19.1	1.000	545	0.50	3.8	0.0	22.9	C		
T	0.04	0.43	14.7	1.000	773	0.50	0.1	0.0	14.8	B	20.6	C
R	0.22	0.43	16.0	1.000	570	0.50	0.8	0.0	16.8	B		
Northbound												
LTR	0.73	0.46	20.0	1.000	752	0.50	4.2	0.0	24.2	C	24.2	C
Southbound												
LTR	0.98	0.46	24.1	1.000	648	0.50	12.8	0.0	36.9	D	36.9	D

Intersection delay = 27.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		306		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.16		
Adjusted opposing flow rate, Vo (veh/h)		57		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		7.65		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.42		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.84		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.39		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.72		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.720		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	9	20	107
Proportion of LT in LT lane group, PLT	0.158	0.000	0.036
Proportion of LT in opposing flow, PLTo	0.00	0.17	0.04
Adjusted opposing flow rate, Vo (veh/h)	33	635	550
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.23	0.50	2.67
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.82	15.88	13.75
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.8	18.5	3.3
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57	0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00	16.32	14.11
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.19	22.49	26.89
n=Max(gq-gf)/2,0)	0.00	0.00	5.40
PTHo=1-PLTo	1.00	0.83	0.96
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.16	0.04	0.17
EL1 (refer to Exhibit C16-3)	1.42	2.63	2.42
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	4.99
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	10.81
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.97	0.77
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.976	0.969	0.768

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	16.32	14.11
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.398	0.344
OCCpedu	0.000	0.058	0.000	0.045
Opposing flow rate, Vo (veh/h)	33	57	635	550
OCCr	0.000	0.053	0.000	0.021
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.947	1.000	0.979
Proportion of left turns, PLT	0.158	1.000	0.036	0.169
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.947	1.000	0.996

Permitted Right Turns

Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.509	1.000	0.344	0.017
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.981	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.5	15.1	0.00	0.0	0.0 0.0 0.0	15.3
Westbound								
L	0.0	0.00	25.5	19.1	0.00	0.0	0.0	22.9
T	0.0	0.00	25.5	14.7	0.00	0.0	0.0	14.8
R	0.0	0.00	25.5	16.0	0.00	0.0	0.0	16.8
Northbound								
LTR	0.0 0.0 0.0	0.00	24.5	20.0	0.00	0.0	0.0 0.0 0.0	24.2
Southbound								
LTR	0.0 0.0 0.0	0.00	24.5	24.1	0.00	0.0	0.0 0.0 0.0	36.9

Intersection Delay	27.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	57			306	33	125	550			635		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1426			1257	1783	1316	1650			1422		
LnCapacity	618			545	773	570	752			648		
Flow Ratio	0.0			0.2	0.0	0.1	0.3			0.4		
v/c Ratio	0.09			0.56	0.04	0.22	0.73			0.98		
Grn Ratio	0.43			0.43	0.43	0.43	0.46			0.46		
I Factor	1.000			0.905			0.663			0.229		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.8			5.7	0.5	2.0	11.2			15.6		
kB	0.8			0.7	0.9	0.7	0.6			0.2		
Q2	0.1			0.8	0.0	0.2	1.6			3.2		
Q Average	0.9			6.6	0.5	2.2	12.8			18.8		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	1.2			8.1	0.7	2.7	15.5			22.6		
QSRatio												
85th Percentile Output:												
fB%	1.6			1.5	1.7	1.6	1.4			1.4		
BOQ	1.5			9.7	0.9	3.4	18.2			26.4		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.6	2.0	1.8	1.5			1.5		
BOQ	1.8			10.7	1.0	3.9	19.7			28.4		
QSRatio												
95th Percentile Output:												
fB%	2.4			1.9	2.5	2.3	1.7			1.6		
BOQ	2.2			12.3	1.3	4.8	21.5			30.5		
QSRatio												
98th Percentile Output:												
fB%	2.9			2.1	3.1	2.7	1.8			1.7		
BOQ	2.7			13.8	1.6	5.8	23.3			32.6		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/22/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 Miti-Action Alt 2
 N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	210		252	227	231		158		217			
Lane Width	16.0			11.0	11.0			11.0				
RTOR Vol			59						0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right	P		
Peds					Peds			
WB Left	P	P			SB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	29.0	10.0				38.0		
Yellow	3.0	3.0				3.0		
All Red	0.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	606	1880	0.81	0.32	38.4	D	38.4	D
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Westbound

L	360	1616	0.76	0.47	45.7	D		
T	794	1701	0.35	0.47	16.5	B	31.0	C

Northbound

LR	607	1437	0.92	0.42	45.0	D	45.0	D
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Southbound

Intersection Delay = 38.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		210	252	227	231		158		217			
% Heavy Veh		5	5	8	8		1		1			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
PK 15 Vol		64	77	68	70		59		81			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		11.0	11.0			11.0				
RTOR Vol			59						0			
Adj Flow		491		273	278			560				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.421				
Prop RTs		0.479			0.000			0.579				
Peds Bikes		0						0		0		
Buses		5		0	0			0				
%InProtPhase				0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.927			0.989			0.917				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P	P			SB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		29.0	10.0					38.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		210	252	227	231		158		217			
PHF		0.82	0.82	0.83	0.83		0.67		0.67			
Adj flow		256	235	273	278		236		324			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		491		273	278			560				
Prop LTs		0.000		1.000	0.000			0.421				
Prop RTs		0.479		0.000				0.579				

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.967	0.967		0.967		
fHV	0.952		0.926	0.926		0.990		
fG	1.000		1.000	1.000		1.000		
fP	1.000		1.000	1.000		0.875		
fBB	0.980		1.000	1.000		1.000		
fA	1.000		1.000	1.000		1.000		
fLU	1.000		1.000	1.000		1.000		
fRT	0.935			1.000		0.922		
fLT	1.000		0.950	1.000		0.979		
Sec.			0.177					
fLpb	1.000		1.000	1.000		1.000		
fRpb	1.000			1.000		1.000		
S	1880		1616	1701		1437		
Sec.			302					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	491	1880	0.26	0.32	606	0.81
Right							
Westbound							
Prot		182	1616	# 0.11	0.167	269	0.68
Perm		91	302	# 0.30	0.300	91	1.00
Left	L	273			0.47	360	0.76
Prot							
Perm							
Thru	T	278	1701	0.16	0.47	794	0.35
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	560	1437	# 0.39	0.42	607	0.92
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							

Control Delay and LOS Determination.

Eastbound												
TR	0.81	0.32	28.0	1.000	606	0.50	10.5	0.0	38.4	D	38.4	D
Westbound												
L	0.76	0.47	31.9	1.000	360	0.50	13.8	0.0	45.7	D		
T	0.35	0.47	15.3	1.000	794	0.50	1.2	0.0	16.5	B	31.0	C
Northbound												
LR	0.92	0.42	24.6	1.000	607	0.50	20.4	0.0	45.0	D	45.0	D
Southbound												

Intersection delay = 38.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		42.0		
Effective permitted green time for LT lane group, g(s)		27.0		
Opposing effective green time, go (s)		29.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		273		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		491		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		6.83		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		12.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.68		
gq, (see Exhibit C16-4,5,6,7,8)		17.11		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		9.89		
n=Max(gq-gf)/2,0)		8.56		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.07		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.15		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.18		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.177		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.421
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	273			
v/c ratio from Capacity Worksheet, X	0.76			
Protected phase effective green interval, g (s)	15.0			
Opposing queue effective green interval, gq	17.11			
Unopposed green interval, gu	9.89			
Red time $r=(C-g-gq-gu)$	48.0			
Arrival rate, $qa=v/(3600(\max[X,1.0]))$	0.08			
Protected ph. departure rate, $Sp=s/3600$	0.449			
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$	0.23			
XPerm	2.51			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	3.42			
Queue at beginning of unsaturated green, Qu	4.94			
Residual queue, Qr	0.00			
Uniform Delay, d1	31.9			

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	30.5	28.0	0.00	0.0	0.0	38.4
	0.0						0.0	
Westbound								
L	0.0	0.00		31.9	0.00	0.0	0.0	45.7
T	0.0	0.00	24.0	15.3	0.00	0.0	0.0	16.5
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	26.0	24.6	0.00	0.0	0.0	45.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			38.2	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	T	LR			
Init Queue	0.0		0.0	0.0	0.0			
Flow Rate	491		273	278	560			
So	1900		1900	1900	1900			
No.Lanes	0	1	0	1	0	0	0	0
SL	1880		771	1701	1437			
LnCapacity	606		360	794	607			
Flow Ratio	0.3		0.4	0.2	0.4			
v/c Ratio	0.81		0.76	0.35	0.92			
Grn Ratio	0.32		0.47	0.47	0.42			
I Factor	0.927		0.989		0.917			
AT or PVG	3		3	3	3			
Pltn Ratio	1.00		1.00	1.00	1.00			
PF2	1.00		1.00	1.00	1.00			
Q1	11.3		4.2	4.4	13.3			
kB	0.7		0.6	1.0	0.7			
Q2	2.7		1.5	0.5	4.8			
Q Average	13.9		5.7	4.9	18.1			
Q Spacing	25.0		25.0	25.0	25.0			
Q Storage	0		0	0	0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2		1.2	1.2	1.2			
BOQ	16.8		7.0	6.1	21.7			
QSRatio								
85th Percentile Output:								
fB%	1.4		1.5	1.5	1.4			
BOQ	19.8		8.5	7.5	25.5			
QSRatio								
90th Percentile Output:								
fB%	1.5		1.7	1.7	1.5			
BOQ	21.3		9.4	8.3	27.4			
QSRatio								
95th Percentile Output:								
fB%	1.7		1.9	2.0	1.6			
BOQ	23.2		10.9	9.8	29.4			
QSRatio								
98th Percentile Output:								
fB%	1.8		2.2	2.3	1.7			
BOQ	25.0		12.4	11.2	31.5			
QSRatio								

ERROR MESSAGES

No errors to report.

Saturday

Midday

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1 L	2 T	3 R	4 L	5 T	6 R	
Volume			330	33	33	398		
Peak-Hour Factor, PHF			0.92	0.92	0.88	0.88		
Hourly Flow Rate, HFR			358	35	37	452		
Percent Heavy Vehicles			--	--	5	--	--	
Median Type/Storage		Undivided			/			
RT Channelized?				No				
Lanes			1 T	1 R		1 L	1 T	
Configuration								
Upstream Signal?			No			No		
Minor Street:	Approach Movement	Westbound				Eastbound		
		7 L	8 T	9 R	10 L	11 T	12 R	
Volume		30		36				
Peak Hour Factor, PHF		0.75		0.75				
Hourly Flow Rate, HFR		40		48				
Percent Heavy Vehicles		3		3				
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/			/
Lanes		1 L		1 R				
Configuration								

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config		L	L		R				
v (vph)	37	40			48				
C(m) (vph)	1149	305			684				
v/c	0.03	0.13			0.07				
95% queue length	0.10	0.45			0.23				
Control Delay	8.2	18.6			10.7				
LOS	A	C			B				
Approach Delay				14.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave & Arthur Kill Rd
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 East/West Street: Englewood Avenue
 North/South Street: Arthur Kill Road
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume		330	33	33	398	
Peak-Hour Factor, PHF		0.92	0.92	0.88	0.88	
Peak-15 Minute Volume		90	9	9	113	
Hourly Flow Rate, HFR		358	35	37	452	
Percent Heavy Vehicles		--	--	5	--	--
Median Type/Storage	Undivided			/		
RT Channelized?			No			
Lanes		1	1	1	1	
Configuration		T	R	L	T	
Upstream Signal?		No			No	
Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	30		36			
Peak Hour Factor, PHF	0.75		0.75			
Peak-15 Minute Volume	10		12			
Hourly Flow Rate, HFR	40		48			
Percent Heavy Vehicles	3		3			
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?			No			
Lanes	1		1			
Configuration	L		R			

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)		4.1	7.1		6.2			
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)		5	3		3			
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)		0.00	0.70		0.00			
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage		4.2	6.4		6.2			
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)		2.20	3.50		3.30			
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)		5	3		3			
t(f)		2.2	3.5		3.3			

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
 Arrival Type
 Effective Green, g (sec)
 Cycle Length, C (sec)
 R_p (from Exhibit 16-11)
 Proportion vehicles arriving on green P
 $g(q_1)$
 $g(q_2)$
 $g(q)$

Computation 2-Proportion of TWSC Intersection Time blocked				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
alpha				
beta				
Travel time, t(a) (sec)				
Smoothing Factor, F				
Proportion of conflicting flow, f				
Max platooned flow, V(c,max)				
Min platooned flow, V(c,min)				
Duration of blocked period, t(p)				
Proportion time blocked, p		0.000		0.000

Computation 3-Platoon Event Periods	Result
$p(2)$	0.000
$p(5)$	0.000
$p(dom)$	
$p(subo)$	
Constrained or unconstrained?	

Proportion unblocked for minor movements, $p(x)$	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
$p(1)$			
$p(4)$			
$p(7)$			
$p(8)$			
$p(9)$			
$p(10)$			
$p(11)$			
$p(12)$			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
$V_{c,x}$		393	884		358			
s								
P_x								
$V_{c,u,x}$								
$C_{r,x}$								
$C_{plat,x}$								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
--	--------	--------	--------	--------	--------	--------	--------	--------

V(c,x)								
s		1500						
P(x)								
V(c,u,x)								

C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
---------------------------	---	----

Conflicting Flows	358	
Potential Capacity	684	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	684	
Probability of Queue free St.	0.93	1.00

Step 2: LT from Major St.	4	1
---------------------------	---	---

Conflicting Flows	393	
Potential Capacity	1149	
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity	1149	
Probability of Queue free St.	0.97	1.00
Maj L-Shared Prob Q free St.		

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	0.97	0.97
Movement Capacity		
Probability of Queue free St.	1.00	1.00

Step 4: LT from Minor St.	7	10
---------------------------	---	----

Conflicting Flows	884	
Potential Capacity	315	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		0.97
Maj. L, Min T Adj. Imp Factor.		0.98
Cap. Adj. factor due to Impeding mvmnt	0.97	0.91
Movement Capacity	305	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
---------------------------	---	----

Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 0.97 0.97
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 884
Potential Capacity 315
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 0.97
Maj. L, Min T Adj. Imp Factor. 0.98
Cap. Adj. factor due to Impeding mvmnt 0.97 0.91
Movement Capacity 305

Results for Two-stage process:
a
y
C t 305

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	40		48			
Movement Capacity (vph)	305		684			
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	305		684			
Volume	40		48			
Delay						
Q sep						
Q sep +1 round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config		L	L		R			
v (vph)		37	40		48			
C(m) (vph)		1149	305		684			
v/c		0.03	0.13		0.07			
95% queue length		0.10	0.45		0.23			
Control Delay		8.2	18.6		10.7			
LOS		A	C		B			
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	0.97
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		8.2
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/19/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig	LTR			LT R			LT R			L TR		
Volume	0	10	5	430	27	547	5	192	447	317	242	0
Lane Width	15.5			11.0			12.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	29.0				21.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	842	1743	0.02	0.48	8.1	A	8.1	A
-----	-----	------	------	------	-----	---	-----	---

Westbound

LT	633	1309	0.78	0.48	21.0	C	30.3	C
R	625	1293	0.95	0.48	38.2	D		

Northbound

LT	624	1783	0.35	0.35	15.7	B	31.6	C
R	538	1538	0.91	0.35	38.6	D		

Southbound

L	370	1056	0.94	0.35	52.8	D		
TR	619	1769	0.43	0.35	17.1	B	37.3	D

Intersection Delay = 32.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/19/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	430	27	547	5	192	447	317	242	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	117	7	149	2	53	123	87	66	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900	1900	1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
LGConfig		LTR			LT	R		LT	R	L	TR	
Lane Width		15.5			11.0	10.0		12.0	12.0	10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			496	595		216	491	348	266	
%InSharedLn												
Prop LTs		0.000			0.942			0.023		1.000	0.000	
Prop RTs		0.313			0.000	1.000		0.000	1.000		0.000	
Peds Bikes	0			0		0	0			0		0
Buses		0			0	0		2	0	0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0	0.0	0.0	0.0	
Arriv. Type		3			3	3		3	3	3	3	
Unit Ext.		3.0			3.0	3.0		3.0	3.0	3.0	3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0	2.0	2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		29.0						21.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	430	27	547	5	192	447	317	242	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	467	29	595	5	211	491	348	266	0
No. Lanes	0	1	0	0	1	1	0	1	1	1	1	0
Lane group	LTR			LT R			LT R			L TR		
Adj flow	16			496 595			216 491			348 266		
Prop LTs	0.000			0.942			0.023			1.000 0.000		
Prop RTs	0.313			0.000 1.000			0.000 1.000			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LT R			L TR		
So	1900			1900 1900			1900 1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	1	1	1	0	0
fW	1.117			0.967 0.933			1.000 1.000			0.933 0.967		
fHV	0.980			0.980 0.980			0.952 0.952			0.971 0.971		
fG	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000 1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.992 1.000			1.000 0.992		
fA	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000 1.000			1.000 1.000		
fRT	0.958			1.000 0.850			1.000 0.850			1.000		
fLT	1.000			0.727			0.993			0.614 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000 1.000			1.000		
S	1743			1309 1293			1783 1538			1056 1769		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.48	842	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	496	1309	0.38	0.48	633	0.78
Right	R	595	1293	# 0.46	0.48	625	0.95
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	216	1783	0.12	0.35	624	0.35
Right	R	491	1538	0.32	0.35	538	0.91
Southbound							
Prot							
Perm							
Left	L	348	1056	# 0.33	0.35	370	0.94
Prot							
Perm							
Thru	TR	266	1769	0.15	0.35	619	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.79
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.95

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.48	8.1	1.000	842	0.50	0.0	0.0	8.1	A	8.1	A
Westbound												
LT	0.78	0.48	12.9	1.000	633	0.50	8.1	0.0	21.0	C	30.3	C
R	0.95	0.48	14.8	1.000	625	0.50	23.3	0.0	38.2	D		
Northbound												
LT	0.35	0.35	14.4	1.000	624	0.50	1.3	0.0	15.7	B	31.6	C
R	0.91	0.35	18.6	1.000	538	0.50	20.0	0.0	38.6	D		
Southbound												
L	0.94	0.35	18.9	1.000	370	0.50	33.9	0.0	52.8	D		
TR	0.43	0.35	14.9	1.000	619	0.50	2.2	0.0	17.1	B	37.3	D

Intersection delay = 32.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				21.0
Effective permitted green time for LT lane group, g(s)				21.0
Opposing effective green time, go (s)				21.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				348
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.02
Adjusted opposing flow rate, Vo (veh/h)				216
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/C				5.80
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				3.60
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.65
gq, (see Exhibit C16-4,5,6,7,8)				0.32
gu=g-gq if gq>=gf, or = g-gf if gq<gf				20.68
n=Max(gq-gf)/2,0)				0.16
PTHo=1-PLTo				0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				1.61
EL2=Max((1-Ptho**n)/Plto, 1.0)				1.00
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.19
gdifff=max(gq-gf,0)				0.32
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.61
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.614

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	29.0	29.0	21.0	
Effective permitted green time for LT lane group, g(s)	29.0	29.0	21.0	
Opposing effective green time, go (s)	29.0	29.0	21.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	0	467	5	
Proportion of LT in LT lane group, PLT	0.000	0.942	0.023	0.000
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	496	16	266	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.78	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	8.27	0.27	4.43	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	13.1	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.52	0.52	0.65	
gq, (see Exhibit C16-4,5,6,7,8)	7.27	0.00	1.76	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.73	29.00	7.90	
n=Max(gq-gf)/2,0)	3.63	0.00	0.00	
PTHo=1-PLTo	0.06	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.02	
EL1 (refer to Exhibit C16-3)	2.29	1.40	1.82	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.06			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.13	0.10	
gdifff=max(gq-gf,0)	7.27	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.75	0.73	0.99	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.727	0.993	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	29.0		21.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	7.27		1.76	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.251		0.084	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	496		266	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.023	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		29.0		21.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		29.0		21.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	15.5	8.1	0.00	0.0	0.0	8.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	15.5	12.9	0.00	0.0	0.0	21.0
R	0.0	0.00	15.5	14.8	0.00	0.0	0.0	38.2
Northbound								
	0.0						0.0	
LT	0.0	0.00	19.5	14.4	0.00	0.0	0.0	15.7
R	0.0	0.00	19.5	18.6	0.00	0.0	0.0	38.6
Southbound								
L	0.0	0.00	19.5	18.9	0.00	0.0	0.0	52.8
TR	0.0	0.00	19.5	14.9	0.00	0.0	0.0	17.1
	0.0						0.0	
Intersection Delay			32.3	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LT	R	L	TR
Init Queue	0.0		0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	16		496	595	216	491	348	266
So	1900		1900	1900	1900	1900	1900	1900
No.Lanes	0 1 0	0	1 1	0	1 1	1 1	1 1	0
SL	1743		1309	1293	1783	1538	1056	1769
LnCapacity	842		633	625	624	538	370	619
Flow Ratio	0.0		0.4	0.5	0.1	0.3	0.3	0.2
v/c Ratio	0.02		0.78	0.95	0.35	0.91	0.94	0.43
Grn Ratio	0.48		0.48	0.48	0.35	0.35	0.35	0.35
I Factor	1.000		0.849		0.861			1.000
AT or PVG	3		3	3	3	3	3	3
Pltn Ratio	1.00		1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Q1	0.1		6.9	9.5	2.7	7.8	5.6	3.4
kB	0.8		0.5	0.5	0.5	0.5	0.4	0.6
Q2	0.0		1.7	4.7	0.3	3.2	3.2	0.5
Q Average	0.2		8.6	14.1	2.9	11.0	8.8	3.9
Q Spacing	25.0		25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0		0	0	0	0	0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.3	1.2	1.2	1.2
BOQ	0.2		10.5	17.1	3.7	13.4	10.7	4.8
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.4	1.6	1.4	1.5	1.5
BOQ	0.3		12.5	20.0	4.6	15.8	12.7	5.9
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.5	1.8	1.6	1.6	1.7
BOQ	0.3		13.7	21.6	5.2	17.2	13.9	6.7
QSRatio								
95th Percentile Output:								
fB%	2.6		1.8	1.7	2.2	1.7	1.8	2.1
BOQ	0.4		15.3	23.5	6.3	18.9	15.6	7.9
QSRatio								
98th Percentile Output:								
fB%	3.2		2.0	1.8	2.5	1.9	2.0	2.4
BOQ	0.5		17.0	25.3	7.5	20.6	17.2	9.2
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Rch Valley Rd & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/22/13 Jurisd: Staten Island, NY
 Period: Saturday 12:15-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Volume				107		235	652	93		168	743	
Lane Width					12.0		15.0			10.0	10.0	
RTOR Vol						0		0				

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left		
	Thru						Thru	P	
	Right						Right	P	
	Peds						Peds	X	
WB	Left	P				SB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		18.0					32.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

Westbound

LR 441 1470 0.87 0.30 39.3 D 39.3 D

Northbound

TR 1066 1998 0.77 0.53 15.3 B 15.3 B

Southbound

L 216 405 0.86 0.53 23.5 C
 T 920 1725 0.89 0.53 16.3 B 17.6 B

Intersection Delay = 20.5 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Saturday 12:15-1:45 PM Peak Pd
 Intersection: Rch Valley Rd & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Richmond Valley Road N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume				107		235	652	93		168	743	
% Heavy Veh				1		1	2	2		2	2	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
PK 15 Vol				30		66	179	26		46	204	
Hi Ln Vol												
% Grade					0			0			0	
Ideal Sat					1900			1900		1900	1900	
ParkExist						X						
NumPark						5						
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
LGConfig					LR			TR		L	T	
Lane Width					12.0			15.0		10.0	10.0	
RTOR Vol						0			0			
Adj Flow					384			818		185	816	
%InSharedLn												
Prop LTs					0.313			0.000		1.000	0.000	
Prop RTs					0.688			0.125			0.000	
Peds Bikes	0			0		0	0		0			
Buses					0			2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet				0.0			0.0			0.0	0.0	
Arriv. Type				3			3			3	3	
Unit Ext.				3.0			3.0			3.0	3.0	
I Factor				0.940			0.789				0.272	
Lost Time				2.0			2.0			2.0	2.0	
Ext of g				2.0			2.0			2.0	2.0	
Ped Min g	11.8			11.8			14.1					

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left						NB	Left		
	Thru							Thru	P	
	Right							Right	P	
	Peds							Peds	X	
WB	Left	P					SB	Left	P	
	Thru							Thru	P	
	Right	P						Right		
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		18.0							32.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V				107		235	652	93		168	743	
PHF				0.89		0.89	0.91	0.91		0.91	0.91	
Adj flow				120		264	716	102		185	816	
No. Lanes	0	0	0	0	0	0	0	1	0	1	1	0
Lane group					LR			TR		L	T	
Adj flow					384			818		185	816	
Prop LTs					0.313			0.000		1.000	0.000	
Prop RTs					0.688			0.125			0.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG				LR			TR			L T		
So				1900			1900			1900	1900	
Lanes	0	0	0	0	0	0	1	0		1	1	0
fW				1.000			1.100			0.933	0.933	
fHV				0.990			0.980			0.980	0.980	
fG				1.000			1.000			1.000	1.000	
fP				0.875			1.000			1.000	1.000	
fBB				1.000			0.992			1.000	0.992	
fA				1.000			1.000			1.000	1.000	
FLU				1.000			1.000			1.000	1.000	
fRT				0.907			0.983				1.000	
fLT				0.985			1.000			0.233	1.000	
Sec.												
fLpb				1.000			1.000			1.000	1.000	
fRpb				1.000			1.000				1.000	
S				1470			1998			405	1725	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru							
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LR	384	1470	# 0.26	0.30	441	0.87
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	818	1998	0.41	0.53	1066	0.77
Right							
Southbound							
Prot							
Perm							
Left	L	185	405	0.46	0.53	216	0.86
Prot							
Perm							
Thru	T	816	1725	# 0.47	0.53	920	0.89
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.73
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.88

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
Westbound												
LR	0.87	0.30	19.9	1.000	441	0.50	19.4	0.0	39.3	D	39.3	D
Northbound												
TR	0.77	0.53	11.1	1.000	1066	0.50	4.2	0.0	15.3	B	15.3	B
Southbound												
L	0.86	0.53	12.0	1.000	216	0.50	11.5	0.0	23.5	C		
T	0.89	0.53	12.4	1.000	920	0.50	3.9	0.0	16.3	B	17.6	B

Intersection delay = 20.5 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				32.0
Effective permitted green time for LT lane group, g(s)				32.0
Opposing effective green time, go (s)				32.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				185
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				818
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				3.08
Opposing lane util. factor, fLUo	1.000		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				13.63
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.47
gq, (see Exhibit C16-4,5,6,7,8)				11.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf				20.88
n=Max(gq-gf)/2,0)				5.56
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.80
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g				0.13
gdiff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.23
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdiff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.233

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.313 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				32.0
Conflicting pedestrian volume, Vped (p/h)				0
Pedestrian flow rate, Vpedg (p/h)				0
OCCpedg				0.000
Opposing queue clearing green, gq (s)				11.12
Eff. ped. green consumed by opp. veh. queue, gq/gp				0.348
OCCpedu				0.000
Opposing flow rate, Vo (veh/h)				818
OCCr				0.000
Number of cross-street receiving lanes, Nrec				1
Number of turning lanes, Nturn				1
ApbT				1.000
Proportion of left turns, PLT				1.000
Proportion of left turns using protected phase, PLTA				0.000
Left-turn adjustment, fLpb				1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	18.0	32.0		
Conflicting pedestrian volume, Vped (p/h)	0	0		
Conflicting bicycle volume, Vbic (bicycles/h)	0	0		
Vpedg	0	0		
OCCpedg	0.000	0.000		
Effective green, g (s)	18.0	32.0		
Vbicg	0	0		

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.688	0.125
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Westbound								
	0.0						0.0	
LR	0.0	0.00	21.0	19.9	0.00	0.0	0.0	39.3
	0.0						0.0	
Northbound								
	0.0						0.0	
TR	0.0	0.00	14.0	11.1	0.00	0.0	0.0	15.3
	0.0						0.0	
Southbound								
L	0.0	0.00	14.0	12.0	0.00	0.0	0.0	23.5
T	0.0	0.00	14.0	12.4	0.00	0.0	0.0	16.3
	0.0						0.0	

Intersection Delay	20.5	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound				Westbound		Northbound		Southbound	
LaneGroup					LR		TR		L	T
Init Queue					0.0		0.0		0.0	0.0
Flow Rate					384		818		185	816
So					1900		1900		1900	1900
No.Lanes	0	0	0	0	0	0	0	1	1	0
SL					1470		1998		405	1725
LnCapacity					441		1066		216	920
Flow Ratio					0.3		0.4		0.5	0.5
v/c Ratio					0.87		0.77		0.86	0.89
Grn Ratio					0.30		0.53		0.53	0.53
I Factor					0.940		0.789			0.272
AT or PVG					3		3		3	3
Pltn Ratio					1.00		1.00		1.00	1.00
PF2					1.00		1.00		1.00	1.00
Q1					6.1		10.8		2.6	12.0
kB					0.5		0.7		0.1	0.2
Q2					2.3		2.2		0.4	1.5
Q Average					8.4		13.0		3.1	13.6
Q Spacing					25.0		25.0		25.0	25.0
Q Storage					0		0		0	0
Q S Ratio										
70th Percentile Output:										
fB%					1.2		1.2		1.3	1.2
BOQ					10.2		15.6		3.9	16.4
QSRatio										
85th Percentile Output:										
fB%					1.5		1.4		1.6	1.4
BOQ					12.2		18.4		4.8	19.3
QSRatio										
90th Percentile Output:										
fB%					1.6		1.5		1.8	1.5
BOQ					13.4		19.9		5.4	20.8
QSRatio										
95th Percentile Output:										
fB%					1.8		1.7		2.1	1.7
BOQ					15.0		21.7		6.6	22.6
QSRatio										
98th Percentile Output:										
fB%					2.0		1.8		2.5	1.8
BOQ					16.6		23.5		7.7	24.5
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Volume	176	464	227	272	772	102	243	479	221	243	140	159
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds					Peds			
WB Left	P	P			SB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds					Peds			
NB Right		P			EB Right			
SB Right					WB Right			
Green	30.0	6.0			14.0	11.0	10.0	
Yellow	3.0	3.0			3.0	3.0	3.0	
All Red	0.0	2.0			0.0	0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	292	1728	0.65	0.43	42.3	D		
T	627	1881	0.80	0.33	34.5	C	34.0	C
R	497	1492	0.39	0.33	24.5	C		
Westbound								
L	315	1765	0.90	0.44	63.5	E		
TR	1191	3457	0.93	0.34	41.3	D	45.8	D
Northbound								
DefL	362	1787	0.75	0.31	38.9	D		
T	595	1913	0.89	0.31	48.0	D	38.9	D
R	647	1492	0.38	0.43	19.0	B		
Southbound								
L	373	1728	0.77	0.27	45.2	D		
TR	431	1616	0.83	0.27	45.4	D	45.3	D

Intersection Delay = 41.3 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	176	464	227	272	772	102	243	479	221	243	140	159
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	47	125	61	71	247	33	68	133	61	72	42	47
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	189	499	192	283	1107		270	532	246	289	356	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.000	1.000		0.106			0.000	1.000		0.531	
Peds Bikes	0			0			0			0		
Buses	0	0	0	0	0		0	0	0	0	0	
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
I Factor		0.700			0.903			1.000			0.855	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0	2.0	2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P		P			NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds							Peds		
WB	Left	P		P			SB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds							Peds		
NB	Right			P			EB	Right		
SB	Right						WB	Right		
Green		30.0	6.0					14.0	11.0	10.0
Yellow		3.0	3.0					3.0	3.0	3.0
All Red		0.0	2.0					0.0	0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	176	464	227	272	772	102	243	479	221	243	140	159
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	189	499	192	283	990	117	270	532	246	289	167	189
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR		DefL	T	R	L	TR	
Adj flow	189	499	192	283	1107		270	532	246	289	356	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.106			0.000	1.000		0.531	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		DefL	T	R	L	TR	
So	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
Lanes	1	1	1	1	2	0	0	2	1	1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.000	1.017	0.933	0.967	0.933	
fHV	0.990	0.990	0.990	0.971	0.971		0.990	0.990	0.990	0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		0.984			1.000	0.850		0.920	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.143			0.166			0.286			0.466		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000	1.000		1.000	
S	1728	1881	1492	1765	3457		1787	1913	1492	1728	1616	
Sec.	260			307			537			848		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		108	1728	0.06	0.122	211	0.51
Perm		81	260	0.31	0.311	81	1.00
Left	L	189			0.43	292	0.65
Prot							
Perm							
Thru	T	499	1881	0.27	0.33	627	0.80
Right	R	192	1492	0.13	0.33	497	0.39
Westbound							
Prot		184	1765	# 0.10	0.122	216	0.85
Perm		99	307	# 0.32	0.322	99	1.00
Left	L	283			0.44	315	0.90
Prot							
Perm							
Thru	TR	1107	3457	0.32	0.34	1191	0.93
Right							
Northbound							
Prot		270	1787	0.15	0.156	278	0.97
Perm		0	537	0.00	0.156	84	0.00
Left	DefL	270			0.31	362	0.75
Prot							
Perm							
Thru	T	532	1913	# 0.28	0.31	595	0.89
Right	R	246	1492	0.16	0.43	647	0.38
Southbound							
Prot		204	1728	0.12	0.167	288	0.71
Perm		85	848	0.10	0.100	85	1.00
Left	L	289			0.27	373	0.77
Prot							
Perm							
Thru	TR	356	1616	# 0.22	0.27	431	0.83
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.07

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.65	0.43	34.8	1.000	292	0.50	7.6	0.0	42.3	D		
T	0.80	0.33	27.2	1.000	627	0.50	7.3	0.0	34.5	C	34.0	C
R	0.39	0.33	23.0	1.000	497	0.50	1.6	0.0	24.5	C		
Westbound												
L	0.90	0.44	35.3	1.000	315	0.50	28.2	0.0	63.5	E		
TR	0.93	0.34	28.4	1.000	1191	0.50	12.8	0.0	41.3	D	45.8	D
Northbound												
DefL	0.75	0.31	25.8	1.000	362	0.50	13.1	0.0	38.9	D		
T	0.89	0.31	29.6	1.000	595	0.50	18.4	0.0	48.0	D	38.9	D
R	0.38	0.43	17.3	1.000	647	0.50	1.7	0.0	19.0	B		
Southbound												
L	0.77	0.27	32.6	1.000	373	0.50	12.6	0.0	45.2	D		
TR	0.83	0.27	31.0	1.000	431	0.50	14.3	0.0	45.4	D	45.3	D

Intersection delay = 41.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	39.0	39.0	28.0	24.0
Effective permitted green time for LT lane group, g(s)	28.0	29.0	14.0	9.0
Opposing effective green time, go (s)	31.0	30.0	24.0	28.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	1	1	2
Adjusted LT flow rate, VLT (veh/h)	189	283	270	289
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	1107	499	356	532
Lost time for LT lane group, tL	5.00	4.00	3.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	4.72	7.08	6.75	7.23
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	14.54	12.48	8.90	6.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67	0.73	0.69
gq, (see Exhibit C16-4,5,6,7,8)	23.15	19.01	14.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.85	9.99	0.00	9.00
n=Max(gq-gf)/2,0)	11.57	9.51	7.00	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.87	2.08	1.82	2.15
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14	0.14	0.29	0.44
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14	0.17	0.29	0.47
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.143	0.166	0.286	0.466

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>qg, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	189	283	270	289
v/c ratio from Capacity Worksheet, X	0.65	0.90	0.75	0.77
Protected phase effective green interval, g (s)	11.0	11.0	14.0	15.0
Opposing queue effective green interval, gq	23.15	19.01	10.00	0.00
Unopposed green interval, gu	4.85	9.99	4.00	9.00
Red time r=(C-g-gq-gu)	51.0	50.0	62.0	66.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.05	0.08	0.08	0.08
Protected ph. departure rate, Sp=s/3600	0.480	0.490	0.496	0.480
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.42	0.25	0.52	0.24
XPerm	2.05	2.51	0.50	2.84
XProt			0.82	
Case	5	5	1	5
Queue at beginning of green arrow, Qa	2.13	3.74	4.65	3.90
Queue at beginning of unsaturated green, Qu	3.89	5.43	0.75	5.30
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	34.8	35.3	25.8	32.6

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		34.8	0.00	0.0	0.0	42.3
T	0.0	0.00	30.0	27.2	0.00	0.0	0.0	34.5
R	0.0	0.00	30.0	23.0	0.00	0.0	0.0	24.5
Westbound								
L	0.0	0.00		35.3	0.00	0.0	0.0	63.5
TR	0.0	0.00	29.5	28.4	0.00	0.0	0.0	41.3
	0.0						0.0	
Northbound								
DefL	0.0	0.00		25.8	0.00	0.0	0.0	38.9
T	0.0	0.00	31.0	29.6	0.00	0.0	0.0	48.0
R	0.0	0.00	25.5	17.3	0.00	0.0	0.0	19.0
Southbound								
L	0.0	0.00		32.6	0.00	0.0	0.0	45.2
TR	0.0	0.00	33.0	31.0	0.00	0.0	0.0	45.4
	0.0						0.0	

Intersection Delay 41.3 sec/veh Intersection LOS D

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	L	T	R	L	TR	DefL	T	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	189	499	192	283	581	270	532	246	289	356	
So	1900	1900	1900	2050	1900	1900	1900	1900	1900	1900	
No.Lanes	1	1	1	1	2	0	2	1	1	1	0
SL	674	1881	1492	708	1815	1162	1913	1492	1398	1616	
LnCapacity	292	627	497	315	625	362	595	647	373	431	
Flow Ratio	0.3	0.3	0.1	0.4	0.3	0.2	0.3	0.2	0.2	0.2	
v/c Ratio	0.65	0.80	0.39	0.90	0.93	0.75	0.89	0.38	0.77	0.83	
Grn Ratio	0.43	0.33	0.33	0.44	0.34	0.31	0.31	0.43	0.27	0.27	
I Factor		0.700			0.903		1.000			0.855	
AT or PVG	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	2.9	11.3	3.7	4.4	14.0	5.3	12.7	4.2	6.1	8.4	
kB	0.3	0.6	0.5	0.5	0.7	0.6	0.8	0.8	0.5	0.5	
Q2	0.6	2.0	0.3	2.5	5.1	1.5	4.3	0.5	1.5	2.1	
Q Average	3.5	13.3	4.0	6.9	19.1	6.7	17.0	4.7	7.6	10.5	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	4.4	16.1	5.0	8.5	23.0	8.2	20.5	5.8	9.2	12.7	
QSRatio											
85th Percentile Output:											
fB%	1.5	1.4	1.5	1.5	1.4	1.5	1.4	1.5	1.5	1.4	
BOQ	5.4	18.9	6.1	10.2	26.9	9.9	24.0	7.1	11.1	15.0	
QSRatio											
90th Percentile Output:											
fB%	1.7	1.5	1.7	1.6	1.5	1.6	1.5	1.7	1.6	1.6	
BOQ	6.1	20.4	6.9	11.2	28.9	11.0	25.8	7.9	12.2	16.4	
QSRatio											
95th Percentile Output:											
fB%	2.1	1.7	2.1	1.9	1.6	1.9	1.6	2.0	1.8	1.7	
BOQ	7.3	22.2	8.2	12.8	31.0	12.5	27.8	9.3	13.8	18.0	
QSRatio											
98th Percentile Output:											
fB%	2.4	1.8	2.4	2.1	1.7	2.1	1.7	2.3	2.0	1.9	
BOQ	8.6	24.0	9.5	14.4	33.1	14.1	29.8	10.7	15.4	19.7	
QSRatio											

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/22/13

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Tyrellan Ave

Area Type: All other areas

Jurisd: SFR NB-DefL = 2050

Year : 2020 Miti-Action Alt 2

N/S St: Tyrellan Avenue

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Volume	81	198	609	235	645	25	345	268	115	26	831	167
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds	X	X	
WB Left	P	P			SB Left	P	P	
Thru	P	P			Thru	P	P	
Right	P	P			Right	P	P	
Peds	X	X			Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0	10.0			15.0	14.0	9.0	
Yellow	3.0	3.0			3.0	3.0	3.0	
All Red	0.0	2.0			0.0	0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	80	313	1.10	0.26	154.7	F		
TR	804	3145	1.09	0.26	90.4	F	96.3	F
Westbound								
DefL	382	1787	0.79	0.40	46.5	D		
TR	748	1871	1.15	0.40	107.2	F	91.4	F
Northbound								
DefL	403	1992	0.91	0.29	61.7	E		
TR	536	1857	0.79	0.29	40.5	D	50.4	D
Southbound								
L	368	1685	0.08	0.36	19.8	B		
TR	1150	3233	0.93	0.36	42.8	D	42.2	D

Intersection Delay = 71.0 (sec/veh) Intersection LOS = E

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: SFR NB-DefL = 2050
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	81	198	609	235	645	25	345	268	115	26	831	167
% Heavy Veh	2	2	2	1	1	1	1	1	1	0	0	0
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
PK 15 Vol	22	54	165	75	207	8	92	74	32	7	223	45
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900		2050	1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
LGConfig	L	TR		DefL	TR		DefL	TR		L	TR	
Lane Width	11.0	12.0		12.0	12.0		13.0	13.0		10.0	9.5	
RTOR Vol			0			0			0			0
Adj Flow	88	877		301	859		367	421		28	1074	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.755			0.037			0.299			0.168	
Peds Bikes	0	0		0	0		0	0		0		
Buses	0	0		0	0		0	0		0	0	
%InProtPhase				0.0			0.0			0.0		
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3		3	3		3	3		3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.830			0.865			1.000			1.000	
Lost Time	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		18.6			16.6			20.1			19.8	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	P
	Thru	P						Thru	P	P
	Right	P						Right	P	P
	Peds	X						Peds	X	X
WB	Left	P	P				SB	Left	P	P
	Thru	P	P					Thru	P	P
	Right	P	P					Right	P	P
	Peds	X	X					Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		23.0	10.0					15.0	14.0	9.0
Yellow		3.0	3.0					3.0	3.0	3.0
All Red		0.0	2.0					0.0	0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	81	198	609	235	645	25	345	268	115	26	831	167
PHF	0.92	0.92	0.92	0.78	0.78	0.78	0.94	0.91	0.91	0.93	0.93	0.93
Adj flow	88	215	662	301	827	32	367	295	126	28	894	180
No. Lanes	1	2	0	0	2	0	0	2	0	1	2	0
Lane group	L	TR		DefL	TR		DefL	TR		L	TR	
Adj flow	88	877		301	859		367	421		28	1074	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.755			0.037			0.299			0.168	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		DefL	TR		DefL	TR		L	TR	
So	1900	1900		1900	1900		2050	1900		1900	1900	
Lanes	1	2	0	0	2	0	0	2	0	1	2	0
fW	0.967	1.000		1.000	1.000		1.033	1.033		0.933	0.917	
fHV	0.980	0.980		0.990	0.990		0.990	0.990		1.000	1.000	
fG	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	0.952		1.000	1.000		1.000	1.000		1.000	0.952	
fRT		0.887			0.994			0.955			0.975	
fLT	0.174	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.				0.190			0.333			0.259		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	313	3145		1787	1871		1992	1857		1685	3233	
Sec.				358			699			459		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	88	313	# 0.28	0.26	80	1.10
Prot							
Perm							
Thru	TR	877	3145	0.28	0.26	804	1.09
Right							
Westbound							
Prot		217	1787	0.12	0.167	298	0.73
Perm		84	358	0.23	0.233	84	1.00
Left	DefL	301			0.40	382	0.79
Prot							
Perm							
Thru	TR	859	1871	# 0.40	0.40	748	1.15
Right							
Northbound							
Prot		274	1992	0.14	0.156	310	0.88
Perm		93	699	0.13	0.133	93	1.00
Left	DefL	367			0.29	403	0.91
Prot							
Perm							
Thru	TR	421	1857	# 0.23	0.29	536	0.79
Right							
Southbound							
Prot		28	1685	0.02	0.167	281	0.10
Perm		0	459	0.00	0.189	87	0.00
Left	L	28			0.36	368	0.08
Prot							
Perm							
Thru	TR	1074	3233	# 0.33	0.36	1150	0.93
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.24
Total lost time per cycle, L = 16.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.51

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	1.10	0.26	33.5	1.000	80	0.50	121.2	0.0	154.7	F		
TR	1.09	0.26	33.5	1.000	804	0.50	56.9	0.0	90.4	F	96.3	F
Westbound												
DefL	0.79	0.40	33.2	1.000	382	0.50	13.3	0.0	46.5	D		
TR	1.15	0.40	27.0	1.000	748	0.50	80.2	0.0	107.2	F	91.4	F
Northbound												
DefL	0.91	0.29	34.5	1.000	403	0.50	27.2	0.0	61.7	E		
TR	0.79	0.29	29.4	1.000	536	0.50	11.0	0.0	40.5	D	50.4	D
Southbound												
L	0.08	0.36	19.4	1.000	368	0.50	0.4	0.0	19.8	B		
TR	0.93	0.36	28.0	1.000	1150	0.50	14.8	0.0	42.8	D	42.2	D

Intersection delay = 71.0 (sec/veh) Intersection LOS = E

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	23.0	36.0	26.0	32.0
Effective permitted green time for LT lane group, g(s)	23.0	21.0	12.0	17.0
Opposing effective green time, go (s)	36.0	23.0	32.0	26.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	2	2	2
Adjusted LT flow rate, VLT (veh/h)	88	301	367	28
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	859	877	1074	421
Lost time for LT lane group, tL	3.00	5.00	5.00	3.00
Computation				
LT volume per cycle, LTC=VLT/C	2.20	7.53	9.18	0.70
Opposing lane util. factor, fLUo	1.000	0.952	0.952	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	10.74	11.52	14.10	5.26
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.60	0.74	0.64	0.71
gq, (see Exhibit C16-4,5,6,7,8)	13.92	18.04	3.47	8.48
gu=g-gq if gq>=gf, or = g-gf if gq<gf	9.08	2.96	8.53	8.52
n=Max(gq-gf)/2,0)	6.96	9.02	1.74	4.24
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	2.91	3.08	3.75	1.94
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.17	0.19	0.33	0.24
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.17	0.19	0.33	0.26
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.174	0.190	0.333	0.259

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 0.952 0.952 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	23.0	23.0		14.0
Conflicting pedestrian volume, Vped (p/h)	0	0		0
Pedestrian flow rate, Vpedg (p/h)	0	0		0
OCCpedg	0.000	0.000		0.000
Opposing queue clearing green, gq (s)	13.92	18.04		8.48
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.605	0.784		0.605
OCCpedu	0.000	0.000		0.000
Opposing flow rate, Vo (veh/h)	859	877		421
OCCr	0.000	0.000		0.000
Number of cross-street receiving lanes, Nrec	2	2		2
Number of turning lanes, Nturn	1	1		1
ApbT	1.000	1.000		1.000
Proportion of left turns, PLT	1.000	1.000		1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000		0.000
Left-turn adjustment, fLpb	1.000	1.000		1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	23.0	36.0	26.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	23.0	36.0	26.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	2	2
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	0.755	0.037	0.299
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
90.0 sec				
Adj. LT vol from Vol Adjustment Worksheet, v	301	367	28	
v/c ratio from Capacity Worksheet, X	0.79	0.91	0.08	
Protected phase effective green interval, g (s)	15.0	14.0	15.0	
Opposing queue effective green interval, gq	14.04	3.47	8.48	
Unopposed green interval, gu	4.00	8.53	8.52	
Red time $r=(C-g-gq-gu)$	57.0	64.0	58.0	
Arrival rate, $qa=v/(3600(\max[X,1.0]))$	0.08	0.10	0.01	
Protected ph. departure rate, $Sp=s/3600$	0.496	0.553	0.468	
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$	0.57	0.27	0.25	
XPerm	2.74	3.33	0.06	
XProt			0.08	
Case	5	5	1	
Queue at beginning of green arrow, Qa	3.99	5.42	0.45	
Queue at beginning of unsaturated green, Qu	5.94	6.88	0.07	
Residual queue, Qr	0.00	0.00	0.00	
Uniform Delay, d1	33.2	34.5	19.4	

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	33.5	33.5	0.00	2.0	0.0	154.7
TR	0.0	0.00	33.5	33.5	0.00	18.2	0.0	90.4
	0.0						0.0	
Westbound								
DefL	0.0	0.00		33.2	0.00	0.0	0.0	46.5
TR	0.0	0.00	27.0	27.0	0.00	27.8	0.0	107.2
	0.0						0.0	
Northbound								
DefL	0.0	0.00		34.5	0.00	0.0	0.0	61.7
TR	0.0	0.00	32.0	29.4	0.00	0.0	0.0	40.5
	0.0						0.0	
Southbound								
L	0.0	0.00		19.4	0.00	0.0	0.0	19.8
TR	0.0	0.00	29.0	28.0	0.00	0.0	0.0	42.8
	0.0						0.0	

Intersection Delay 71.0 sec/veh Intersection LOS E

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		DefL	TR		DefL	TR		L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0	
Flow Rate	88	460		301	859		367	421		28	564	
So	1900	1900		1900	1900		2050	1900		1900	1900	
No.Lanes	1	2	0	0	2	0	0	2	0	1	2	0
SL	313	1651		953	1871		1395	1857		1034	1698	
LnCapacity	80	422		382	748		403	536		368	603	
Flow Ratio	0.3	0.3		0.3	0.5		0.3	0.2		0.0	0.3	
v/c Ratio	1.10	1.09		0.79	1.15		0.91	0.79		0.08	0.94	
Grn Ratio	0.26	0.26		0.40	0.40		0.29	0.29		0.36	0.36	
I Factor		0.830			0.865			1.000			1.000	
AT or PVG	3	3		3	3		3	3		3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Q1	2.2	11.5		5.2	21.5		7.6	9.7		0.5	13.6	
kB	0.2	0.5		0.5	0.8		0.6	0.7		0.6	0.8	
Q2	1.9	8.3		1.6	18.5		3.5	2.3		0.0	5.5	
Q Average	4.1	19.8		6.8	40.0		11.1	12.0		0.5	19.1	
Q Spacing	25.0	25.0		25.0	25.0		25.0	25.0		25.0	25.0	
Q Storage	0	0		0	0		0	0		0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2	1.2		1.3	1.2	
BOQ	5.1	23.8		8.3	48.0		13.4	14.5		0.6	22.9	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.5	1.4		1.4	1.4		1.7	1.4	
BOQ	6.3	27.9		10.1	56.0		15.9	17.1		0.8	26.8	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5		1.6	1.5		1.6	1.5		2.0	1.5	
BOQ	7.1	29.9		11.1	60.0		17.2	18.6		1.0	28.8	
QSRatio												
95th Percentile Output:												
fB%	2.0	1.6		1.9	1.6		1.7	1.7		2.5	1.6	
BOQ	8.4	32.1		12.6	64.0		18.9	20.3		1.3	31.0	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.7		2.1	1.7		1.9	1.8		3.1	1.7	
BOQ	9.7	34.3		14.2	68.1		20.6	22.0		1.5	33.1	
QSRatio												

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.
WARNING: Phase 6 < minimum green time for peds.
WARNING: Phase 7 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Boscombe Ave & OBX Off-Ramp
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Sat Flw Rate EB-L = 2100
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L		R
Volume	888	484			517	1150				241		215
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0
RTOR Vol						0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left			
Thru	P	P			Thru			
Right					Right			
Peds					Peds			
WB Left					SB Left	P		
Thru		P			Thru			
Right	P	P			Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right	P				WB Right	P		
Green	38.0	24.0				13.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

L	916	1909	1.00	0.76	42.2	D		
T	1225	1646	0.41	0.74	4.8	A	28.9	C

Westbound

T	502	1881	1.10	0.27	82.3	F	26.5	C
R	1599	1599	0.74	1.00	0.6	A		

Northbound

Southbound

L	468	3239	0.56	0.14	40.6	D	25.4	C
R	928	1492	0.25	0.62	8.3	A		

Intersection Delay = 27.3 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & OBX Off-Ramp
 Area Type: All other areas
 Jurisdiction: Sat Flw Rate EB-L = 2100
 Analysis Year: 2020 FULL Mitigation Alt. 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Outerbridge Crossing Off-Ramp

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound			
	L	T	R	L	T	R	L	T	R	L	T	R	
Volume	888	484			517	1150				241		215	
% Heavy Veh	1	1			1	1				1		1	
PHF	0.97	0.96			0.94	0.97				0.92		0.92	
PK 15 Vol	229	126			138	296				65		58	
Hi Ln Vol													
% Grade		0			0						0		
Ideal Sat	2100	1900			1900	1900				1900		1900	
ParkExist			X										
NumPark			5										
No. Lanes	1	1	0		0	1	1	0	0	0	2	0	1
LGConfig	L	T			T	R				L	T	R	
Lane Width	11.0	12.0			12.0	12.0				10.0		10.0	
RTOR Vol						0						0	
Adj Flow	915	504			550	1186				262		234	
%InSharedLn													
Prop LTS	1.000	0.000			0.000								
Prop RTs		0.000			0.000	1.000						1.000	
Peds Bikes					0			0			0		
Buses	0	0			0	0				0		0	
%InProtPhase													
Duration	0.25			Area Type: All other areas									

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0	0.0				0.0		0.0
Arriv. Type	3	3			3	3				3		3
Unit Ext.	3.0	3.0			3.0	3.0				3.0		3.0
I Factor		0.508			0.176						1.000	
Lost Time	2.0	2.0			2.0	2.0				2.0		2.0
Ext of g	3.0	2.0			2.0	2.0				2.0		2.0
Ped Min g					24.6			3.2			20.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
WB	Left					SB	Left	P	
	Thru		P				Thru		
	Right	P	P				Right	P	
	Peds						Peds		
NB	Right					EB	Right		
SB	Right	P				WB	Right	P	
Green		38.0	24.0					13.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound				Westbound				Northbound				Southbound		
	L	T	R		L	T	R		L	T	R		L	T	R
Volume, V	888	484			517	1150							241		215
PHF	0.97	0.96			0.94	0.97							0.92		0.92
Adj flow	915	504			550	1186							262		234
No. Lanes	1	1	0		0	1	1		0	0	0		2	0	1
Lane group	L	T			T	R			L	T			L	T	R
Adj flow	915	504			550	1186			262				262		234
Prop LTs	1.000	0.000			0.000										
Prop RTs	0.000				0.000	1.000								1.000	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound				Westbound				Northbound				Southbound		
	L	T			T	R			L	T			L	T	R
So	2100	1900			1900	1900			1900				1900		1900
Lanes	1	1	0	0	1	1	0	0	0	2	0	1			
fW	0.967	1.000			1.000	1.000				0.933		0.933			
fHV	0.990	0.990			0.990	0.990				0.990		0.990			
fG	1.000	1.000			1.000	1.000*				1.000		1.000			
fP	1.000	0.875			1.000	1.000				1.000		1.000			
fBB	1.000	1.000			1.000	1.000				1.000		1.000			
fA	1.000	1.000			1.000	1.000				1.000		1.000			
fLU	1.000	1.000			1.000	1.000				0.971		1.000			
fRT		1.000			1.000	0.850						0.850			
fLT	0.950	1.000			1.000					0.950					
Sec.	0.138														
fLpb	1.000	1.000			1.000					1.000					
fRpb		1.000			1.000	1.000						1.000			
S	1909	1646			1881	1599				3239		1492			
Sec.	277														

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Northbound

Southbound

L 0.56 0.14 35.8 1.000 468 0.50 4.8 0.0 40.6 D 25.4 C

R 0.25 0.62 7.6 1.000 928 0.50 0.7 0.0 8.3 A

Intersection delay = 27.3 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	67.0			
Effective permitted green time for LT lane group, g(s)	29.0			
Opposing effective green time, go (s)	24.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	1			
Adjusted LT flow rate, VLT (veh/h)	915			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	550			
Lost time for LT lane group, tL	4.00			
Computation				
LT volume per cycle, LTC=VLTC/3600	22.88			
Opposing lane util. factor, fLUo	1.000	1.000		
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	13.75			
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.73			
gq, (see Exhibit C16-4,5,6,7,8)	29.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	0.00			
n=Max(gq-gf)/2,0)	14.50			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	2.18			
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.14			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.138			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

 For special case of single-lane approach opposed by multilane approach,
 see text.
 * If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
 left-turn lane and redo calculations.
 ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach
 or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

EB WB NB SB

Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Pedestrian flow rate, Vpedg (p/h)
 OCCpedg
 Opposing queue clearing green, gq (s)
 Eff. ped. green consumed by opp. veh. queue, gq/gp
 OCCpedu
 Opposing flow rate, Vo (veh/h)
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion of left turns, PLT
 Proportion of left turns using protected phase, PLTA
 Left-turn adjustment, fLpb
 Permitted Right Turns
 Effective pedestrian green time, gp (s)
 Conflicting pedestrian volume, Vped (p/h)
 Conflicting bicycle volume, Vbic (bicycles/h)
 Vpedg
 OCCpedg
 Effective green, g (s)
 Vbicg

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v	915			
v/c ratio from Capacity Worksheet, X	1.00			
Protected phase effective green interval, g (s)	39.0			
Opposing queue effective green interval, gq	25.00			
Unopposed green interval, gu	4.00			
Red time r=(C-g-gq-gu)	22.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.25			
Protected ph. departure rate, Sp=s/3600	0.530			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.56			
XPerm	3.30			
XProt	0.75			
Case	3			
Queue at beginning of green arrow, Qa	10.73			
Queue at beginning of unsaturated green, Qu	6.35			
Residual queue, Qr	5.14			
Uniform Delay, d1	21.2			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		21.2	0.00	0.0	0.0	42.2
T	0.0	0.00	11.5	4.2	0.00	0.0	0.0	4.8
	0.0						0.0	
Westbound								
	0.0						0.0	
T	0.0	0.00	33.0	33.0	0.00	12.0	0.0	82.3
R	0.0	0.00	0.0	0.0	0.00	0.0	0.0	0.6
Northbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Southbound								
L	0.0	0.00	38.5	35.8	0.00	0.0	0.0	40.6
	0.0						0.0	
R	0.0	0.00	17.0	7.6	0.00	0.0	0.0	8.3
Intersection Delay 27.3 sec/veh Intersection LOS C								

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	L	T		T	R				L	R	
Init Queue	0.0	0.0		0.0	0.0				0.0	0.0	
Flow Rate	915	504		550	1186				134	234	
So	2100	1900		1900	1900				1900	1900	
No.Lanes	1	1	0	1	1	0	0	0	2	0	1
SL	1213	1646		1881	1599				1668	1492	
LnCapacity	916	1225		502	1599				240	928	
Flow Ratio	0.8	0.3		0.3	0.7				0.1	0.2	
v/c Ratio	1.00	0.41		1.10	0.74				0.56	0.25	
Grn Ratio	0.76	0.74		0.27	1.00				0.14	0.62	
I Factor		0.508		0.176						1.000	
AT or PVG	3	3		3	3				3	3	
Pltn Ratio	1.00	1.00		1.00	1.00				1.00	1.00	
PF2	1.00	1.00		1.00					1.00	1.00	
Q1	9.9	4.6		13.8					3.1	2.6	
kB	0.5	0.7		0.1	0.3				0.4	1.1	
Q2	7.8	0.5		7.2	0.8				0.5	0.4	
Q Average	17.7	5.1		20.9					3.6	3.0	
Q Spacing	25.0	25.0		25.0	25.0				25.0	25.0	
Q Storage	0	0		0	0				0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.2	1.2		1.2					1.2	1.3	
BOQ	21.3	6.3		25.2					4.5	3.7	
QSRatio											
85th Percentile Output:											
fB%	1.4	1.5		1.4					1.5	1.6	
BOQ	24.9	7.7		29.4					5.6	4.7	
QSRatio											
90th Percentile Output:											
fB%	1.5	1.7		1.5					1.7	1.8	
BOQ	26.8	8.6		31.6					6.3	5.3	
QSRatio											
95th Percentile Output:											
fB%	1.6	2.0		1.6					2.1	2.2	
BOQ	28.8	10.0		33.8					7.6	6.4	
QSRatio											
98th Percentile Output:											
fB%	1.7	2.2		1.7					2.4	2.5	
BOQ	30.9	11.4		36.1					8.8	7.5	
QSRatio											

ERROR MESSAGES

No errors to report.

Analyst: KM	Inter.: Boscombe Ave & Tyrellan Ave
Agency: AECOM	Area Type: All other areas
Date: 7/22/2013	Jurisd: Staten Island, NY
Period: Saturday 12:45-1:45 PM Peak Pd	Year : 2020 Miti-Action Alt 2
Project ID: Charleston EIS	
E/W St: Boscombe Avenue	N/S St: Tyrellan Avenue

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
LGConfig	DefL	TR			LTR			LTR			LT	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
DefL	841	2025	0.84	0.50	31.1	C		
TR	1066	2132	0.05	0.50	11.6	B	29.9	C

LTR	1089	3266	0.09	0.33	20.8	C	20.8	C
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LTR	1184	3045	0.00	0.39	16.8	B	16.8	B
-----	------	------	------	------	------	---	------	---

LT	544	1399	0.17	0.39	18.5	B	202.7	F
R	924	1599	1.42	0.58	215.3	F		

Intersection Delay = 136.8 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Boscombe Ave & Tyrellan Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Boscombe Avenue N/S St: Tyrellan Avenue

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	682	46	0	0	46	58	0	0	1	84	0	1622
% Heavy Veh	1	1	1	1	1	1	1	1	1	1	1	1
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
PK 15 Vol	178	12	0	0	13	16	0	0	1	23	0	436
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900			1900			1900			1900	1900
ParkExist												
NumPark												
No. Lanes		0	2	0		0	2	0		0	1	1
LGConfig		DefL	TR			LTR		LTR			LT	R
Lane Width	16.0	16.0			11.5			12.0			12.0	12.0
RTOR Vol			0			14			0			398
Adj Flow	710	48			99			1			90	1316
%InSharedLn												
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000
Peds Bikes		0	0		0	0		0	0		0	0
Buses	0	0			0			0			0	0
%InProtPhase	0.0											0.0
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0			0.0			0.0			0.0	0.0
Arriv. Type	3	3			3			3			3	3
Unit Ext.	3.0	3.0			3.0			3.0			3.0	3.0
I Factor		0.967			1.000			1.000			0.855	
Lost Time	2.0	2.0			2.0			2.0			2.0	2.0
Ext of g	2.0	2.0			2.0			2.0			2.0	2.0
Ped Min g		20.3			17.5			20.3			20.3	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds	X	X				Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right		P			WB	Right		
Green		30.0	12.0					35.0	
Yellow		3.0	3.0					3.0	
All Red		0.0	2.0					2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	682	46	0	0	46	58	0	0	1	84	0	1622
PHF	0.96	0.96	0.96	0.91	0.91	0.91	0.90	0.90	0.90	0.93	0.93	0.93
Adj flow	710	48	0	0	51	48	0	0	1	90	0	1316
No. Lanes	0	2	0	0	2	0	0	2	0	0	1	1
Lane group	DefL	TR			LTR			LTR			LT	R
Adj flow	710	48			99			1			90	1316
Prop LTs	1.000	0.000			0.000			0.000			1.000	
Prop RTs		0.000			0.485			1.000			0.000	1.000

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound	
	DefL	TR		LTR			LTR			LT	R
So	1900	1900		1900			1900			1900	1900
Lanes	0	2	0	2	0	0	2	0	0	1	1
fW	1.133	1.133		0.983			1.000			1.000	1.000
fHV	0.990	0.990		0.990			0.990			0.990	0.990
fG	1.000	1.000		1.000			1.000			1.000	1.000
fP	1.000	1.000		1.000			1.000			1.000	1.000
fBB	1.000	1.000		1.000			1.000			1.000	1.000
fA	1.000	1.000		1.000			1.000			1.000	1.000
fLU	1.000	1.000		0.952			0.952			1.000	1.000
fRT		1.000		0.927			0.850			1.000	0.850
fLT	0.950	1.000		1.000			1.000			0.744	
Sec.	0.690										
fLpb	1.000	1.000		1.000			1.000			1.000	
fRpb		1.000		1.000			1.000			1.000	1.000
S	2025	2132		3266			3045			1399	1599
Sec.	1471										

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot	DefL	252	2025	0.12	0.189	383	0.66
Perm		458	1471	# 0.31	0.311	458	1.00
Left		710			0.50	841	0.84
Prot	TR	48	2132	0.02	0.50	1066	0.05
Perm							
Thru							
Right	LTR	99	3266	0.03	0.33	1089	0.09
Prot							
Perm							
Left	LTR	1	3045	0.00	0.39	1184	0.00
Prot							
Perm							
Thru	LT	90	1399	0.06	0.39	544	0.17
Right							
Prot	R	1316	1599	# 0.82	0.58	924	1.42
Perm							
Left							
Prot	LT	90	1399	0.06	0.39	544	0.17
Perm							
Thru							
Right	R	1316	1599	# 0.82	0.58	924	1.42

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.13
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.28

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
DefL	0.84	0.50	21.3	1.000	841	0.50	9.8	0.0	31.1	C			
TR	0.05	0.50	11.5	1.000	1066	0.50	0.1	0.0	11.6	B	29.9	C	
Westbound													
LTR	0.09	0.33	20.6	1.000	1089	0.50	0.2	0.0	20.8	C	20.8	C	
Northbound													
LTR	0.00	0.39	16.8	1.000	1184	0.50	0.0	0.0	16.8	B	16.8	B	
Southbound													
LT	0.17	0.39	18.0	1.000	544	0.50	0.6	0.0	18.5	B	202.7	F	

R 1.42 0.58 19.0 1.000 924 0.50 196.3 0.0 215.3 F

Intersection delay = 136.8 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	45.0			
Effective permitted green time for LT lane group, g(s)	28.0			
Opposing effective green time, go (s)	30.0			
Number of lanes in LT lane group, N	1			
Number of lanes in opposing approach, No	2			
Adjusted LT flow rate, VLT (veh/h)	710			
Proportion of LT in LT lane group, PLT	1.000			
Proportion of LT in opposing flow, PLTo	0.00			
Adjusted opposing flow rate, Vo (veh/h)	99			
Lost time for LT lane group, tL	5.00			
Computation				
LT volume per cycle, LTC=VLT/C	17.75			
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.30			
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0			
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00			
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67			
gq, (see Exhibit C16-4,5,6,7,8)	0.00			
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00			
n=Max(gq-gf)/2,0)	0.00			
PTHo=1-PLTo	1.00			
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00			
EL1 (refer to Exhibit C16-3)	1.45			
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.14			
gdifff=max(gq-gf,0)	0.00			
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.69			
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.690			

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		30.0	35.0	35.0
Effective permitted green time for LT lane group, g(s)		30.0	35.0	35.0
Opposing effective green time, go (s)		45.0	35.0	35.0
Number of lanes in LT lane group, N		2	2	1

Number of lanes in opposing approach, No	2	1	2
Adjusted LT flow rate, VLT (veh/h)	0	0	90
Proportion of LT in LT lane group, PLT	0.000	0.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	1.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	48	90	1
Lost time for LT lane group, tL	3.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.00	0.00	2.25
Opposing lane util. factor, fLUo	0.952	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.60	2.25	0.01
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	2.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.50	0.61	0.61
gq, (see Exhibit C16-4,5,6,7,8)	0.00	0.00	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	30.00	35.00	32.77
n=Max(gq-gf)/2,0)	0.00	0.00	0.00
PTHo=1-PLTo	1.00	0.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.00	1.00
EL1 (refer to Exhibit C16-3)	1.45	1.51	1.38
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.07	0.06	0.11
gdifff=max(gq-gf,0)	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	1.00	1.00	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	1.000	1.000	0.744

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Pedestrian flow rate, Vpedg (p/h)	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Opposing queue clearing green, gq (s)	0.00	0.00	0.00	0.00
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.000	0.000
OCCpedu	0.000	0.000	0.000	0.000
Opposing flow rate, Vo (veh/h)	99	48	90	1
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	2	1	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion of left turns, PLT	1.000	0.000	0.000	1.000
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	1.000	1.000	1.000
Permitted Right Turns				
Effective pedestrian green time, gp (s)	45.0	30.0	35.0	35.0
Conflicting pedestrian volume, Vped (p/h)	0	0	0	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	0	0	0	0
OCCpedg	0.000	0.000	0.000	0.000
Effective green, g (s)	45.0	30.0	35.0	35.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.000	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	2	2	2
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	1.000	1.000	1.000
Proportion right-turns, PRT	0.000	0.485	1.000	1.000
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000	1.000	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v	710			
v/c ratio from Capacity Worksheet, X	0.84			
Protected phase effective green interval, g (s)	17.0			
Opposing queue effective green interval, gq	0.00			
Unopposed green interval, gu	28.00			
Red time r=(C-g-gq-gu)	45.0			
Arrival rate, qa=v/(3600(max[X,1.0]))	0.20			
Protected ph. departure rate, Sp=s/3600	0.563			
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.41			
XPerm	1.26			
XProt				
Case	5			
Queue at beginning of green arrow, Qa	2.96			
Queue at beginning of unsaturated green, Qu	8.88			
Residual queue, Qr	0.00			
Uniform Delay, d1	21.3			

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
DefL	0.0	0.00		21.3	0.00	0.0	0.0	31.1
TR	0.0	0.00	22.5	11.5	0.00	0.0	0.0	11.6
	0.0						0.0	
Westbound								
	0.0						0.0	
LTR	0.0	0.00	30.0	20.6	0.00	0.0	0.0	20.8
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	27.5	16.8	0.00	0.0	0.0	16.8
	0.0						0.0	
Southbound								
	0.0						0.0	
LT	0.0	0.00	27.5	18.0	0.00	0.0	0.0	18.5
R	0.0	0.00	19.0	19.0	0.00	98.0	0.0	215.3
Intersection Delay			136.8	sec/veh	Intersection LOS F			

BACK OF QUEUE WORKSHEET

	Eastbound				Westbound				Northbound				Southbound		
LaneGroup	DefL	TR			LTR				LTR				LT	R	
Init Queue	0.0	0.0			0.0				0.0				0.0	0.0	
Flow Rate	710	48			51				0				90	1316	
So	1900	1900			1900				1900				1900	1900	
No.Lanes	0	2	0	0	2	0	0	0	2	0	0	0	1	1	
SL	1680	2132			1715				1599				1399	1599	
LnCapacity	841	1066			571				621				544	924	
Flow Ratio	0.4	0.0			0.0				0.0				0.1	0.8	
v/c Ratio	0.84	0.05			0.09				0.00				0.17	1.42	
Grn Ratio	0.50	0.50			0.33				0.39				0.39	0.58	
I Factor		0.967			1.000				1.000				0.855		
AT or PVG	3	3			3				3				3	3	
Pltn Ratio	1.00	1.00			1.00				1.00				1.00	1.00	
PF2	1.00	1.00			1.00				1.00				1.00	1.00	
Q1	10.6	0.6			0.9				0.0				1.5	32.9	
kB	1.0	1.2			0.8				0.8				0.6	0.9	
Q2	4.2	0.1			0.1				0.0				0.1	51.9	
Q Average	14.8	0.7			1.0				0.0				1.6	84.8	
Q Spacing	25.0	25.0			25.0				25.0				25.0	25.0	
Q Storage	0	0			0				0				0	0	
Q S Ratio															
70th Percentile Output:															
fB%	1.2	1.3			1.3				1.3				1.3	1.2	
BOQ	17.8	0.9			1.2				0.0				2.0	102	
QSRatio															
85th Percentile Output:															
fB%	1.4	1.7			1.6				1.7				1.6	1.4	
BOQ	20.9	1.1			1.6				0.0				2.6	119	
QSRatio															
90th Percentile Output:															
fB%	1.5	1.9			1.9				2.0				1.9	1.5	
BOQ	22.5	1.3			1.8				0.0				3.0	127	
QSRatio															
95th Percentile Output:															
fB%	1.7	2.5			2.4				2.6				2.3	1.6	
BOQ	24.4	1.7			2.3				0.0				3.7	136	
QSRatio															
98th Percentile Output:															
fB%	1.8	3.0			2.9				3.2				2.8	1.7	
BOQ	26.3	2.0			2.8				0.0				4.5	144	
QSRatio															

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Veterans Rd W
 Agency: AECOM Area Type: All other areas
 Date: 7/22/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig	TR			L LT			L LTR					
Volume	1	0		795	2		5			28	982	1
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol		0									0	

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left					NB Left	P		
Thru	P				Thru			
Right	P				Right			
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right					Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	28.0				22.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	878	1881	0.00	0.47	8.5	A	8.5	A
----	-----	------	------	------	-----	---	-----	---

Westbound

L	680	1458	0.96	0.47	41.9	D		
LT	654	1401	0.34	0.47	11.5	B	34.3	C

Northbound

L	120	322	0.05	0.37	13.0	B	13.0	B
---	-----	-----	------	------	------	---	------	---

Southbound

LTR	1796	4898	0.63	0.37	17.4	B	17.4	B
-----	------	------	------	------	------	---	------	---

Intersection Delay = 24.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Veterans Rd W
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road West

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	0		795	2		5			28	982	1
% Heavy Veh	1	1		2	2		0			2	2	2
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
PK 15 Vol	1	0		218	1		2			8	276	1
Hi Ln Vol												
% Grade	0			0			0			0		
Ideal Sat	1900			1900	1900		1900			1900		
ParkExist												
NumPark												
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
LGConfig		TR		L	LT		L				LTR	
Lane Width	12.0			13.0	13.0		10.0			11.0		
RTOR Vol			0									0
Adj Flow	1			656	220		6			1135		
%InSharedLn				25								
Prop LTs		0.000		1.000	0.993		1.000				0.027	
Prop RTs	0.000			0.000						0.001		
Peds Bikes	0						0			0		
Buses	0			0	0		0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0			0.0	0.0		0.0			0.0		
Arriv. Type	3			3	3		3			3		
Unit Ext.	3.0			3.0	3.0		3.0			3.0		
I Factor	1.000				0.971			0.951		1.000		
Lost Time	2.0			2.0	2.0		2.0			2.0		
Ext of g	2.0			2.0	2.0		2.0			2.0		
Ped Min g	31.2							18.1			11.8	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right		
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right						Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		28.0						22.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	0		795	2		5			28	982	1
PHF	0.75	0.25		0.91	0.91		0.88			0.89	0.89	0.89
Adj flow	1	0		874	2		6			31	1103	1
No. Lanes	0	1	0	1	1	0	1	0	0	0	3	0
Lane group	TR			L LT			L			LTR		
Adj flow	1			656	220		6			1135		
Prop LTs	0.000			1.000 0.993			1.000			0.027		
Prop RTs	0.000			0.000						0.001		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L LT		L		LTR	
So	1900		1900 1900		1900		1900	
Lanes 0	1	0	1	1 0	1	0 0	0	3 0
fW	1.000		1.033 1.033		0.933		0.967	
fHV	0.990		0.980 0.980		1.000		0.980	
fG	1.000		1.000 1.000		1.000		1.000	
fP	1.000		1.000 1.000		1.000		1.000	
fBB	1.000		1.000 1.000		1.000		1.000	
fA	1.000		1.000 1.000		1.000		1.000	
fLU	1.000		1.000 1.000		1.000		0.908	
fRT	1.000		1.000				1.000	
fLT	1.000		0.757 0.728		0.182		0.999	
Sec.								
fLpb	1.000		1.000 1.000		1.000		1.000	
fRpb	1.000		1.000				1.000	
S	1881		1458 1401		322		4898	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	1	1881	0.00	0.47	878	0.00
Right							
Westbound							
Prot							
Perm							
Left	L	656	1458	# 0.45	0.47	680	0.96
Prot							
Perm							
Thru	LT	220	1401	0.16	0.47	654	0.34
Right							
Northbound							
Prot							
Perm							
Left	L	6	322	0.02	0.37	120	0.05
Prot							
Perm							
Thru							
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1135	4898	# 0.23	0.37	1796	0.63
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.82

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
TR	0.00	0.47	8.5	1.000	878	0.50	0.0	0.0	8.5	A	8.5	A
Westbound												
L	0.96	0.47	15.5	1.000	680	0.50	26.4	0.0	41.9	D		
LT	0.34	0.47	10.1	1.000	654	0.50	1.3	0.0	11.5	B	34.3	C
Northbound												
L	0.05	0.37	12.3	1.000	120	0.50	0.7	0.0	13.0	B	13.0	B
Southbound												
LTR	0.63	0.37	15.7	1.000	1796	0.50	1.7	0.0	17.4	B	17.4	B

Intersection delay = 24.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		28.0	22.0	
Effective permitted green time for LT lane group, g(s)		28.0	22.0	
Opposing effective green time, go (s)		28.0	22.0	
Number of lanes in LT lane group, N		1	1	
Number of lanes in opposing approach, No		1	3	
Adjusted LT flow rate, VLT (veh/h)		656	6	
Proportion of LT in LT lane group, PLT		1.000	1.000	
Proportion of LT in opposing flow, PLTo		0.00	0.03	
Adjusted opposing flow rate, Vo (veh/h)		1	1135	
Lost time for LT lane group, tL		5.00	5.00	
Computation				
LT volume per cycle, LTC=VLT/C		10.93	0.10	
Opposing lane util. factor, fLUo	1.000	1.000	0.908	
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		0.02	6.94	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00	1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.53	0.63	
gq, (see Exhibit C16-4,5,6,7,8)		0.00	8.33	
gu=g-gq if gq>=gf, or = g-gf if gq<gf		28.00	13.67	
n=Max(gq-gf)/2,0)		0.00	4.17	
PTHo=1-PLTo		1.00	0.97	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00	1.00	
EL1 (refer to Exhibit C16-3)		1.32	4.21	
EL2=Max((1-Ptho*n)/Plto, 1.0)			3.99	
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.14	0.18	
gdifff=max(gq-gf,0)		0.00	8.33	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.76	0.18	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.757	0.182	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
60.0 sec				
Total actual green time for LT lane group, G (s)		28.0		
Effective permitted green time for LT lane group, g(s)		28.0		
Opposing effective green time, go (s)		28.0		
Number of lanes in LT lane group, N		1		

Number of lanes in opposing approach, No	1		
Adjusted LT flow rate, VLT (veh/h)	218		
Proportion of LT in LT lane group, PLT	0.000	0.993	0.027
Proportion of LT in opposing flow, PLTo	0.00		
Adjusted opposing flow rate, Vo (veh/h)	1		
Lost time for LT lane group, tL	5.00		
Computation			
LT volume per cycle, LTC=VLTC/3600	3.63		
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.53		
gq, (see Exhibit C16-4,5,6,7,8)	0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	28.00		
n=Max(gq-gf)/2,0)	0.00		
PTHo=1-PLTo	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.99		
EL1 (refer to Exhibit C16-3)	1.38		
EL2=Max((1-Ptho**n)/Plto, 1.0)			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.14		
gdifff=max(gq-gf,0)	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.728		

For special case of single-lane approach opposed by multilane approach, see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	TR		L	LT	L		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	1		656	220	6		416	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0		1 1 0		1 0 0		0 3 0	
SL	1881		1458	1401	322		1798	
LnCapacity	878		680	654	120		659	
Flow Ratio	0.0		0.4	0.2	0.0		0.2	
v/c Ratio	0.00		0.96	0.34	0.05		0.63	
Grn Ratio	0.47		0.47	0.47	0.37		0.37	
I Factor	1.000			0.971		0.951	1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.0		10.6	2.3	0.1		5.7	
kB	0.8		0.6	0.6	0.2		0.6	
Q2	0.0		5.9	0.3	0.0		1.1	
Q Average	0.0		16.5	2.6	0.1		6.8	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.3	1.3		1.2	
BOQ	0.0		19.9	3.3	0.1		8.3	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.6	1.7		1.5	
BOQ	0.0		23.3	4.2	0.1		10.0	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.5	1.8	2.0		1.6	
BOQ	0.0		25.0	4.7	0.1		11.0	
QSRatio								
95th Percentile Output:								
fB%	2.6		1.6	2.2	2.6		1.9	
BOQ	0.0		27.0	5.8	0.2		12.6	
QSRatio								
98th Percentile Output:								
fB%	3.2		1.8	2.6	3.2		2.1	
BOQ	0.0		28.9	6.8	0.2		14.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Englewood Ave @ Vets Rd E
 Agency: AECOM Area Type: All other areas
 Date: 7/22/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig	LT R			LTR			LTR					
Volume	217	376	199	0	84	15	712	65	3			
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left			
Thru	P				Thru			
Right	P				Right			
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	26.0				24.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LT	699	1613	1.13	0.43	92.8	F	78.0	E
R	693	1599	0.26	0.43	11.7	B		

Westbound

LTR	694	1601	0.17	0.43	10.9	B	10.9	B
-----	-----	------	------	------	------	---	------	---

Northbound

LTR	1875	4688	0.45	0.40	13.9	B	13.9	B
-----	------	------	------	------	------	---	------	---

Southbound

Intersection Delay = 45.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Englewood Ave @ Vets Rd E
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Englewood Avenue N/S St: Veterans Road East

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	217	376	199	0	84	15	712	65	3			
% Heavy Veh	1	1	1	0	0	0	2	2	2			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
PK 15 Vol	72	125	66	0	25	5	191	17	1			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900	1900		1900			1900				
ParkExist						X						
NumPark						5						
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
LGConfig		LT	R		LTR			LTR				
Lane Width		13.0	12.0		11.5			11.0				
RTOR Vol			66			0			0			
Adj Flow		790	177		119			839				
%InSharedLn												
Prop LTs		0.366			0.000			0.913				
Prop RTs		0.000	1.000		0.151			0.004				
Peds Bikes	0	0		0	0		0	0		0		
Buses		0	0		0			0				
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0	0.0		0.0			0.0				
Arriv. Type		3	3		3			3				
Unit Ext.		3.0	3.0		3.0			3.0				
I Factor		0.997			0.993			0.967				
Lost Time		2.0	2.0		2.0			2.0				
Ext of g		2.0	2.0		2.0			2.0				
Ped Min g		21.2			12.9			14.3		17.5		

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left		
	Thru	P					Thru		
	Right	P					Right		
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		26.0						24.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	217	376	199	0	84	15	712	65	3			
PHF	0.75	0.75	0.75	0.83	0.83	0.83	0.93	0.93	0.93			
Adj flow	289	501	177	0	101	18	766	70	3			
No. Lanes	0	1	1	0	1	0	0	3	0	0	0	0
Lane group	LT R			LTR			LTR					
Adj flow	790 177			119			839					
Prop LTs	0.366			0.000			0.913					
Prop RTs	0.000 1.000			0.151			0.004					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	LT	R	LTR		LTR			
So	1900	1900	1900		1900			
Lanes 0	1	1	0	1	0	0	3	0
fW	1.033	1.000		0.983			0.967	
fHV	0.990	0.990		1.000			0.980	
fG	1.000	1.000		1.000			1.000	
fP	1.000	1.000		0.875			1.000	
fBB	1.000	1.000		1.000			1.000	
fA	1.000	1.000		1.000			1.000	
fLU	1.000	1.000		1.000			0.908	
fRT	1.000	0.850		0.980			0.999	
fLT	0.830			1.000			0.956	
Sec.								
fLpb	1.000			1.000			1.000	
fRpb	1.000	1.000		1.000			1.000	
S	1613	1599		1601			4688	
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Intersection delay = 45.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000		0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	26.0	26.0		
Effective permitted green time for LT lane group, g(s)	26.0	26.0		
Opposing effective green time, go (s)	26.0	26.0		
Number of lanes in LT lane group, N	1	1		

Number of lanes in opposing approach, No	1	1	
Adjusted LT flow rate, VLT (veh/h)	289	0	
Proportion of LT in LT lane group, PLT	0.366	0.000	0.913
Proportion of LT in opposing flow, PLTo	0.00	0.37	
Adjusted opposing flow rate, Vo (veh/h)	119	790	
Lost time for LT lane group, tL	5.00	5.00	
Computation			
LT volume per cycle, LTC=VLTC/3600	4.82	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	0.908
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	1.98	13.17	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.57	0.57	
gq, (see Exhibit C16-4,5,6,7,8)	0.00	14.29	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	26.00	11.71	
n=Max(gq-gf)/2,0)	0.00	7.14	
PTHo=1-PLTo	1.00	0.63	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.37	0.00	
EL1 (refer to Exhibit C16-3)	1.56	3.05	
EL2=Max((1-Ptho**n)/Plto, 1.0)		2.63	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.11	0.08	
gdifff=max(gq-gf,0)	0.00	14.29	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.83	0.45	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.830	1.000	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	26.0	26.0	24.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Pedestrian flow rate, Vpedg (p/h)	0	0	0	
OCCpedg	0.000	0.000	0.000	
Opposing queue clearing green, gq (s)	0.00	14.29		
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.550		
OCCpedu	0.000	0.000		
Opposing flow rate, Vo (veh/h)	119	790	0	
OCCr	0.000	0.000		
Number of cross-street receiving lanes, Nrec	3	1	1	
Number of turning lanes, Nturn	1	1	1	
ApbT	1.000	1.000		
Proportion of left turns, PLT	0.366	0.000	0.913	
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	
Left-turn adjustment, fLpb	1.000	1.000	1.000	
Permitted Right Turns				
Effective pedestrian green time, gp (s)	26.0	26.0	24.0	
Conflicting pedestrian volume, Vped (p/h)	0	0	0	
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	
Vpedg	0	0	0	
OCCpedg	0.000	0.000	0.000	
Effective green, g (s)	26.0	26.0	24.0	
Vbicg	0	0	0	

OCCbicg	0.020	0.020	0.020
OCCr	0.000	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3	1
Number of turning lanes, Nturn	1	1	1
ApbT	1.000	1.000	1.000
Proportion right-turns, PRT	1.000	0.151	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000
Right turn adjustment, fRpb		1.000	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LT	0.0	0.00	17.0	17.0	0.00	22.7	0.0	92.8
R	0.0	0.00	17.0	10.8	0.00	0.0	0.0	11.7
Westbound								
	0.0						0.0	
LTR	0.0	0.00	17.0	10.4	0.00	0.0	0.0	10.9
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	18.0	13.2	0.00	0.0	0.0	13.9
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			45.9	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LT	R	LTR		LTR			
Init Queue	0.0	0.0	0.0		0.0			
Flow Rate	790	177	119		308			
So	1900	1900	1900		1900			
No.Lanes	0 1	1	0 1	0	3 0	0	0	0
SL	1613	1599	1601		1720			
LnCapacity	699	693	694		688			
Flow Ratio	0.5	0.1	0.1		0.2			
v/c Ratio	1.13	0.26	0.17		0.45			
Grn Ratio	0.43	0.43	0.43		0.40			
I Factor	0.997		0.993		0.967			
AT or PVG	3	3	3		3			
Pltn Ratio	1.00	1.00	1.00		1.00			
PF2	1.00	1.00	1.00		1.00			
Q1	13.2	1.9	1.2		3.8			
kB	0.7	0.7	0.7		0.6			
Q2	15.6	0.2	0.1		0.5			
Q Average	28.8	2.1	1.4		4.3			
Q Spacing	25.0	25.0	25.0		25.0			
Q Storage	0	0	0		0			
Q S Ratio								
70th Percentile Output:								
fB%	1.2	1.3	1.3		1.2			
BOQ	34.5	2.7	1.7		5.3			
QSRatio								
85th Percentile Output:								
fB%	1.4	1.6	1.6		1.5			
BOQ	40.3	3.4	2.2		6.5			
QSRatio								
90th Percentile Output:								
fB%	1.5	1.8	1.9		1.7			
BOQ	43.2	3.9	2.5		7.3			
QSRatio								
95th Percentile Output:								
fB%	1.6	2.3	2.4		2.0			
BOQ	46.1	4.8	3.2		8.6			
QSRatio								
98th Percentile Output:								
fB%	1.7	2.7	2.8		2.3			
BOQ	49.0	5.7	3.8		10.0			
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Vets Rd E & Bloomingdale Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/22/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Volume	19		179	301	614	173	149	228		420		17
Lane Width	10.0		13.0		11.0		12.0	12.0		16.0		
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru					Thru	P		
Right	P				Right			
Peds					Peds	X		
WB Left	P	P			SB Left			
Thru	P	P			Thru	P		
Right	P	P			Right	P		
Peds		X			Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	12.0	9.0				24.0		
Yellow	3.0	3.0				3.0		
All Red	2.0	2.0				2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	120	585	0.22	0.20	23.2	C	33.0	C
R	330	1652	0.76	0.20	34.1	C		
Westbound								
LTR	2047	4723	0.61	0.43	13.8	B	13.8	B
Northbound								
L	224	560	0.72	0.40	32.1	C		
T	745	1863	0.33	0.40	13.6	B	20.9	C
Southbound								
TR	848	2121	0.57	0.40	16.1	B	16.1	B

Intersection Delay = 17.7 (sec/veh) Intersection LOS = B

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Vets Rd E & Bloomingdale Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Veterans Rd E/Drumgoole Rd W N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	19		179	301	614	173	149	228		420	17	
% Heavy Veh	1		1	2	2	2	2	2		1	1	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
PK 15 Vol	7		63	86	176	50	40	62		117	5	
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900		1900		1900		1900	1900			1900	
ParkExist												
NumPark												
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
LGConfig	L		R		LTR		L	T			TR	
Lane Width	10.0		13.0		11.0		12.0	12.0			16.0	
RTOR Vol			0			0						0
Adj Flow	27		252		1251		162	248			486	
%InSharedLn												
Prop LTs	1.000				0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000			0.039	
Peds Bikes	0			0		0				0		0
Buses	0		0		0		0	0			0	
%InProtPhase				0.0		0.0						
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0		0.0		0.0		0.0	0.0			0.0	
Arriv. Type	3		3		3		3	3			3	
Unit Ext.	3.0		3.0		3.0		3.0	3.0			3.0	
I Factor		0.717			0.483			0.917			0.747	
Lost Time	2.0		2.0		2.0		2.0	2.0			2.0	
Ext of g	2.0		2.0		2.0		2.0	2.0			2.0	
Ped Min g		17.2			16.9						20.9	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru						Thru	P	
	Right	P					Right		
	Peds						Peds	X	
WB	Left	P	P			SB	Left		
	Thru	P	P				Thru	P	
	Right	P	P				Right	P	
	Peds		X				Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		12.0	9.0					24.0	
Yellow		3.0	3.0					3.0	
All Red		2.0	2.0					2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	19		179	301	614	173	149	228		420	17	
PHF	0.71		0.71	0.87	0.87	0.87	0.92	0.92		0.90	0.90	
Adj flow	27		252	346	706	199	162	248		467	19	
No. Lanes	1	0	1	0	3	0	1	1	0	0	1	0
Lane group	L		R		LTR		L	T			TR	
Adj flow	27		252		1251		162	248			486	
Prop LTs	1.000				0.277		1.000	0.000			0.000	
Prop RTs			1.000		0.159			0.000			0.039	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	L	R	L	R	L	T	L	T
So	1900	1900	1900	1900	1900	1900	1900	1900
Lanes	1	0	1	0	3	0	1	0
fW	0.933	1.033	0.967	0.967	1.000	1.000	1.133	1.133
fHV	0.990	0.990	0.980	0.980	0.980	0.980	0.990	0.990
fG	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fP	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fBB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fA	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
fLU	1.000	1.000	0.908	0.908	1.000	1.000	1.000	1.000
fRT		0.850	0.976	0.976		1.000	0.995	0.995
fLT	0.333		0.986	0.986	0.301	1.000	1.000	1.000
Sec.								
fLpb	1.000		1.000	1.000	1.000	1.000	1.000	1.000
fRpb		1.000	1.000	1.000		1.000	1.000	1.000
S	585	1652	4723	4723	560	1863	2121	2121
Sec.								

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	27	585	0.05	0.20	120	0.22
Prot							
Perm							
Thru							
Right	R	252	1652	0.15	0.20	330	0.76
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1251	4723	# 0.26	0.43	2047	0.61
Right							
Northbound							
Prot							
Perm							
Left	L	162	560	# 0.29	0.40	224	0.72
Prot							
Perm							
Thru	T	248	1863	0.13	0.40	745	0.33
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	TR	486	2121	0.23	0.40	848	0.57
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.55
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.66

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach		
	v/c	g/C				Factor k	Del d2		Delay	LOS	Delay	LOS	
Eastbound													
L	0.22	0.20	20.1	1.000	120	0.50	3.1	0.0	23.2	C	33.0	C	
R	0.76	0.20	22.7	1.000	330	0.50	11.4	0.0	34.1	C			
Westbound													
LTR	0.61	0.43	13.1	1.000	2047	0.50	0.7	0.0	13.8	B	13.8	B	
Northbound													
L	0.72	0.40	15.2	1.000	224	0.50	16.9	0.0	32.1	C	20.9	C	
T	0.33	0.40	12.5	1.000	745	0.50	1.1	0.0	13.6	B			
Southbound													
TR	0.57	0.40	14.0	1.000	848	0.50	2.1	0.0	16.1	B	16.1	B	

Intersection delay = 17.7 (sec/veh) Intersection LOS = B

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	12.0		24.0	
Effective permitted green time for LT lane group, g(s)	12.0		24.0	
Opposing effective green time, go (s)	26.0		24.0	
Number of lanes in LT lane group, N	1		1	
Number of lanes in opposing approach, No	3		1	
Adjusted LT flow rate, VLT (veh/h)	27		162	
Proportion of LT in LT lane group, PLT	1.000		1.000	
Proportion of LT in opposing flow, PLTo	0.28		0.00	
Adjusted opposing flow rate, Vo (veh/h)	1251		486	
Lost time for LT lane group, tL	5.00		5.00	
Computation				
LT volume per cycle, LTC=VLT/C	0.45		2.70	
Opposing lane util. factor, fLUo	0.908		1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.65		8.10	
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0		0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00		1.00	
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57		0.60	
gq, (see Exhibit C16-4,5,6,7,8)	6.65		9.15	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	5.35		14.85	
n=Max(gq-gf)/2,0)	3.32		4.58	
PTHo=1-PLTo	0.72		1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00		1.00	
EL1 (refer to Exhibit C16-3)	4.75		2.06	
EL2=Max((1-Ptho*n)/Plto, 1.0)	2.38			
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.33		0.17	
gdifff=max(gq-gf,0)	6.65		0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.33		0.30	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.333		0.301	

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.277 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.908 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)			24.0	
Conflicting pedestrian volume, Vped (p/h)			0	
Pedestrian flow rate, Vpedg (p/h)			0	
OCCpedg			0.000	
Opposing queue clearing green, gq (s)			9.15	
Eff. ped. green consumed by opp. veh. queue, gq/gp			0.381	
OCCpedu			0.000	
Opposing flow rate, Vo (veh/h)			486	
OCCr			0.000	
Number of cross-street receiving lanes, Nrec			3	
Number of turning lanes, Nturn			1	
ApbT			1.000	
Proportion of left turns, PLT			1.000	
Proportion of left turns using protected phase, PLTA			0.000	
Left-turn adjustment, fLpb			1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	9.0		24.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	0.0		24.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	3
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	0.159	0.039
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb	1.000	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	24.0	20.1	0.00	0.0	0.0	23.2
	0.0						0.0	
R	0.0	0.00	24.0	22.7	0.00	0.0	0.0	34.1
Westbound								
	0.0						0.0	
LTR	0.0	0.00	17.0	13.1	0.00	0.0	0.0	13.8
	0.0						0.0	
Northbound								
L	0.0	0.00	18.0	15.2	0.00	0.0	0.0	32.1
T	0.0	0.00	18.0	12.5	0.00	0.0	0.0	13.6
	0.0						0.0	
Southbound								
	0.0						0.0	
TR	0.0	0.00	18.0	14.0	0.00	0.0	0.0	16.1
	0.0						0.0	
Intersection Delay			17.7	sec/veh	Intersection LOS B			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound	Northbound		Southbound	
LaneGroup	L	R	LTR	L	T	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	27	252	459	162	248	486	
So	1900	1900	1900	1900	1900	1900	
No.Lanes	1 0	1 0	3 0	1 1 0	0	1 0	
SL	585	1652	1733	560	1863	2121	
LnCapacity	120	330	751	224	745	848	
Flow Ratio	0.0	0.2	0.3	0.3	0.1	0.2	
v/c Ratio	0.22	0.76	0.61	0.72	0.33	0.57	
Grn Ratio	0.20	0.20	0.43	0.40	0.40	0.40	
I Factor		0.717	0.483		0.917	0.747	
AT or PVG	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	0.4	4.0	5.9	2.3	2.9	6.3	
kB	0.1	0.3	0.3	0.3	0.6	0.6	
Q2	0.0	0.8	0.5	0.7	0.3	0.8	
Q Average	0.4	4.8	6.4	2.9	3.2	7.1	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	
Q S Ratio							
70th Percentile Output:							
fB%	1.3	1.2	1.2	1.3	1.3	1.2	
BOQ	0.5	6.0	7.9	3.7	4.0	8.6	
QSRatio							
85th Percentile Output:							
fB%	1.7	1.5	1.5	1.6	1.6	1.5	
BOQ	0.7	7.3	9.5	4.6	5.0	10.4	
QSRatio							
90th Percentile Output:							
fB%	2.0	1.7	1.6	1.8	1.8	1.6	
BOQ	0.8	8.1	10.5	5.2	5.6	11.5	
QSRatio							
95th Percentile Output:							
fB%	2.5	2.0	1.9	2.2	2.1	1.8	
BOQ	1.1	9.5	12.1	6.3	6.8	13.0	
QSRatio							
98th Percentile Output:							
fB%	3.1	2.3	2.1	2.5	2.5	2.1	
BOQ	1.3	10.9	13.6	7.5	7.9	14.6	
QSRatio							

ERROR MESSAGES

WARNING: Phase 2 < minimum green time for peds.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Amboy Rd & Bloomingdale Ave
 Agency: AECOM Area Type: All other areas
 Date: 7/31/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig	LTR			L T R			LTR			LTR		
Volume	8	8	18	293	18	105	13	346	241	86	443	8
Lane Width	12.0			12.0	11.0	11.0	11.0			12.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	39.0				41.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR 615 1419 0.07 0.43 15.1 B 15.1 B

Westbound

L 563 1299 0.58 0.43 23.1 C
 T 788 1818 0.03 0.43 14.7 B 21.1 C
 R 586 1352 0.20 0.43 16.5 B

Northbound

LTR 762 1673 0.86 0.46 28.4 C 28.4 C

Southbound

LTR 631 1385 0.95 0.46 38.8 D 38.8 D

Intersection Delay = 29.7 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/31/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Amboy Rd & Bloomingdale Ave
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Pleasant Plains Ave/Amboy Rd N/S St: Amboy Rd/Bloomingdale Ave

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	8	8	18	293	18	105	13	346	241	86	443	8
% Heavy Veh	2	2	2	1	1	1	0	0	0	1	1	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
PK 15 Vol	2	2	5	81	5	29	4	94	65	24	123	2
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900		1900	1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
LGConfig		LTR		L	T	R		LTR			LTR	
Lane Width		12.0		12.0	11.0	11.0		11.0			12.0	
RTOR Vol			0			0			0			0
Adj Flow		41		326	20	117		652			597	
%InSharedLn												
Prop LTS		0.244		1.000	0.000			0.021			0.161	
Prop RTS		0.512			0.000	1.000		0.402			0.015	
Peds Bikes	50	0		0	0	0	50	0		0	0	
Buses	0			0	0	0	0			0		
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0	0.0		0.0			0.0	
Arriv. Type		3		3	3	3		3			3	
Unit Ext.		3.0		3.0	3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.516			0.500	
Lost Time		2.0		2.0	2.0	2.0		2.0			2.0	
Ext of g		2.0		2.0	2.0	2.0		2.0			2.0	
Ped Min g		11.5			11.8			18.9			18.3	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		39.0						41.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	8	8	18	293	18	105	13	346	241	86	443	8
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.90	0.90
Adj flow	10	10	21	326	20	117	14	376	262	96	492	9
No. Lanes	0	1	0	1	1	1	0	1	0	0	1	0
Lane group	LTR			L	T	R	LTR			LTR		
Adj flow	41			326	20	117	652			597		
Prop LTs	0.244			1.000	0.000		0.021			0.161		
Prop RTs	0.512			0.000 1.000			0.402			0.015		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound			Northbound		Southbound	
LG	LTR		L	T	R	LTR		LTR	
So	1900		1900	1900	1900	1900		1900	
Lanes	0	1	0	1	1	0	1	0	0
fw	1.000		1.000	0.967	0.967	0.967		1.000	
fHV	0.980		0.990	0.990	0.990	1.000		0.990	
fG	1.000		1.000	1.000	1.000	1.000		1.000	
fP	0.875		1.000	1.000	0.875	1.000		1.000	
fBB	1.000		1.000	1.000	1.000	1.000		1.000	
fA	1.000		1.000	1.000	1.000	1.000		1.000	
fLU	1.000		1.000	1.000	1.000	1.000		1.000	
fRT	0.931			1.000	0.850	0.946		0.998	
fLT	0.963		0.730	1.000		0.985		0.740	
Sec.									
fLpb	1.000		0.946	1.000		1.000		0.997	
fRpb	0.971			1.000	1.000	0.978		1.000	
S	1419		1299	1818	1352	1673		1385	
Sec.									

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	41	1419	0.03	0.43	615	0.07
Right							
Westbound							
Prot							
Perm							
Left	L	326	1299	# 0.25	0.43	563	0.58
Prot							
Perm							
Thru	T	20	1818	0.01	0.43	788	0.03
Right	R	117	1352	0.09	0.43	586	0.20
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	652	1673	0.39	0.46	762	0.86
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	597	1385	# 0.43	0.46	631	0.95
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.68

Total lost time per cycle, L = 10.00 sec

Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.77

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.07	0.43	14.9	1.000	615	0.50	0.2	0.0	15.1	B	15.1	B
Westbound												
L	0.58	0.43	19.3	1.000	563	0.50	3.8	0.0	23.1	C		
T	0.03	0.43	14.6	1.000	788	0.50	0.1	0.0	14.7	B	21.1	C
R	0.20	0.43	15.8	1.000	586	0.50	0.7	0.0	16.5	B		
Northbound												
LTR	0.86	0.46	21.9	1.000	762	0.50	6.6	0.0	28.4	C	28.4	C
Southbound												
LTR	0.95	0.46	23.4	1.000	631	0.50	15.3	0.0	38.8	D	38.8	D

Intersection delay = 29.7 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)		39.0		
Effective permitted green time for LT lane group, g(s)		39.0		
Opposing effective green time, go (s)		39.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		326		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.24		
Adjusted opposing flow rate, Vo (veh/h)		41		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600		8.15		
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		1.02		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.57		
gq, (see Exhibit C16-4,5,6,7,8)		0.00		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		39.00		
n=Max(gq-gf)/2,0)		0.00		
PTHo=1-PLTo		0.76		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		1.37		
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00		
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.10		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.73		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.730		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	39.0		41.0	41.0
Effective permitted green time for LT lane group, g(s)	39.0		41.0	41.0
Opposing effective green time, go (s)	39.0		41.0	41.0
Number of lanes in LT lane group, N	1		1	1

Number of lanes in opposing approach, No	1	1	1
Adjusted LT flow rate, VLT (veh/h)	10	14	96
Proportion of LT in LT lane group, PLT	0.244	0.000	0.021
Proportion of LT in opposing flow, PLTo	0.00	0.16	0.02
Adjusted opposing flow rate, Vo (veh/h)	20	597	652
Lost time for LT lane group, tL	5.00	5.00	5.00
Computation			
LT volume per cycle, LTC=VLTC/3600	0.25	0.35	2.40
Opposing lane util. factor, fLUo	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	0.50	14.93	16.30
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	23.1	21.3	4.2
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.57	0.54	0.54
gq, (see Exhibit C16-4,5,6,7,8)	0.00	15.34	16.75
gu=g-gq if gq>=gf, or = g-gf if gq<gf	15.86	19.71	24.25
n=Max(gq-gf)/2,0)	0.00	0.00	6.26
PTHo=1-PLTo	1.00	0.84	0.98
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.24	0.02	0.16
EL1 (refer to Exhibit C16-3)	1.40	2.53	2.67
EL2=Max((1-Ptho**n)/Plto, 1.0)		1.00	5.92
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.06	0.05	0.06
gdifff=max(gq-gf,0)	0.00	0.00	12.53
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.96	0.98	0.74
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)			
or flt=[fm+0.91(N-1)]/N**			
Left-turn adjustment, fLT	0.963	0.985	0.740

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	0	50	0	50
Pedestrian flow rate, Vpedg (p/h)	0	115	0	109
OCCpedg	0.000	0.058	0.000	0.055
Opposing queue clearing green, gq (s)	0.00	0.00	15.34	16.75
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.000	0.000	0.374	0.409
OCCpedu	0.000	0.058	0.000	0.043
Opposing flow rate, Vo (veh/h)	20	41	597	652
OCCr	0.000	0.054	0.000	0.018
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	1.000	0.946	1.000	0.982
Proportion of left turns, PLT	0.244	1.000	0.021	0.161
Proportion of left turns using protected phase, PLTA	0.000	0.000	0.000	0.000
Left-turn adjustment, fLpb	1.000	0.946	1.000	0.997

Permitted Right Turns

Effective pedestrian green time, gp (s)	39.0	39.0	41.0	41.0
Conflicting pedestrian volume, Vped (p/h)	50	0	50	0
Conflicting bicycle volume, Vbic (bicycles/h)	0	0	0	0
Vpedg	115	0	109	0
OCCpedg	0.058	0.000	0.055	0.000
Effective green, g (s)	39.0	39.0	41.0	41.0
Vbicg	0	0	0	0

OCCbicg	0.020	0.020	0.020	0.020
OCCr	0.058	0.000	0.055	0.000
Number of cross-street receiving lanes, Nrec	1	1	1	1
Number of turning lanes, Nturn	1	1	1	1
ApbT	0.942	1.000	0.946	1.000
Proportion right-turns, PRT	0.512	1.000	0.402	0.015
Proportion right-turns using protected phase, PRTA	0.000	0.000	0.000	0.000
Right turn adjustment, fRpb	0.971	1.000	0.978	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C				
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	25.5	14.9	0.00	0.0	0.0 0.0 0.0	15.1
Westbound								
L	0.0	0.00	25.5	19.3	0.00	0.0	0.0	23.1
T	0.0	0.00	25.5	14.6	0.00	0.0	0.0	14.7
R	0.0	0.00	25.5	15.8	0.00	0.0	0.0	16.5
Northbound								
LTR	0.0 0.0 0.0	0.00	24.5	21.9	0.00	0.0	0.0 0.0 0.0	28.4
Southbound								
LTR	0.0 0.0 0.0	0.00	24.5	23.4	0.00	0.0	0.0 0.0 0.0	38.8

Intersection Delay	29.7	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	LTR			L	T	R	LTR			LTR		
Init Queue	0.0			0.0	0.0	0.0	0.0			0.0		
Flow Rate	41			326	20	117	652			597		
So	1900			1900	1900	1900	1900			1900		
No.Lanes	0	1	0	1	1	1	0	1	0	0	1	0
SL	1419			1299	1818	1352	1673			1385		
LnCapacity	615			563	788	586	762			631		
Flow Ratio	0.0			0.3	0.0	0.1	0.4			0.4		
v/c Ratio	0.07			0.58	0.03	0.20	0.86			0.95		
Grn Ratio	0.43			0.43	0.43	0.43	0.46			0.46		
I Factor	1.000			0.887			0.516			0.500		
AT or PVG	3			3	3	3	3			3		
Pltn Ratio	1.00			1.00	1.00	1.00	1.00			1.00		
PF2	1.00			1.00	1.00	1.00	1.00			1.00		
Q1	0.6			6.2	0.3	1.8	14.5			14.3		
kB	0.8			0.7	0.9	0.7	0.5			0.4		
Q2	0.1			0.9	0.0	0.2	2.5			3.8		
Q Average	0.7			7.1	0.3	2.0	17.0			18.1		
Q Spacing	25.0			25.0	25.0	25.0	25.0			25.0		
Q Storage	0			0	0	0	0			0		
Q S Ratio												
70th Percentile Output:												
fB%	1.3			1.2	1.3	1.3	1.2			1.2		
BOQ	0.8			8.7	0.4	2.5	20.5			21.8		
QSRatio												
85th Percentile Output:												
fB%	1.7			1.5	1.7	1.6	1.4			1.4		
BOQ	1.1			10.4	0.5	3.2	24.0			25.5		
QSRatio												
90th Percentile Output:												
fB%	1.9			1.6	2.0	1.8	1.5			1.5		
BOQ	1.3			11.5	0.6	3.6	25.8			27.4		
QSRatio												
95th Percentile Output:												
fB%	2.5			1.8	2.5	2.3	1.6			1.6		
BOQ	1.6			13.0	0.8	4.5	27.8			29.5		
QSRatio												
98th Percentile Output:												
fB%	3.0			2.1	3.1	2.7	1.8			1.7		
BOQ	2.0			14.6	1.0	5.4	29.7			31.5		
QSRatio												

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/22/2013

Period: Saturday 12:45-1:45 PM Peak Pd

Project ID: Charleston EIS

E/W St: Arthur Kill Road

Inter.: Arthur Kill Rd & Bloomingdl Rd

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 Miti-Action Alt 2

N/S St: Bloomingdale Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig	TR			L T			LR					
Volume	238		239	312		246	159		255			
Lane Width	16.0			11.0	11.0		11.0					
RTOR Vol			56						0			

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB Left	P		
	Thru	P				NB Thru			
	Right	P				NB Right	P		
	Peds					NB Peds			
WB	Left	P	P			SB Left			
	Thru	P	P			SB Thru			
	Right					SB Right			
	Peds					SB Peds			
NB	Right					EB Right			
SB	Right					WB Right			
Green		28.0	14.0				35.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

TR	613	1971	0.88	0.31	45.0	D	45.0	D
----	-----	------	------	------	------	---	------	---

Westbound

L	434	1678	0.81	0.50	45.9	D		
T	883	1766	0.31	0.50	14.3	B	32.0	C

Northbound

LR	557	1431	0.87	0.39	42.0	D	42.0	D
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Southbound

Intersection Delay = 39.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/22/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Arthur Kill Rd & Bloomingdl Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Miti-Action Alt 2
 Project ID: Charleston EIS
 E/W St: Arthur Kill Road N/S St: Bloomingdale Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume		238	239	312	246		159		255			
% Heavy Veh		2	2	4	4		1		1			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
PK 15 Vol		76	77	88	69		47		75			
Hi Ln Vol												
% Grade		0			0			0				
Ideal Sat		1900		1900	1900			1900				
ParkExist									X			
NumPark									5			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
LGConfig		TR		L	T			LR				
Lane Width		16.0		11.0	11.0			11.0				
RTOR Vol			56						0			
Adj Flow		540		351	276			487				
%InSharedLn												
Prop LTs		0.000		1.000	0.000			0.384				
Prop RTs		0.435			0.000			0.616				
Peds Bikes		0						0		0		
Buses		2		0	0			0				
%InProtPhase				0.0								
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0		0.0	0.0			0.0				
Arriv. Type		3		3	3			3				
Unit Ext.		3.0		3.0	3.0			3.0				
I Factor		0.927			0.992			0.953				
Lost Time		2.0		2.0	2.0			2.0				
Ext of g		2.0		2.0	2.0			2.0				
Ped Min g		18.3						15.2			17.2	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left					NB	Left	P	
	Thru	P					Thru		
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P	P			SB	Left		
	Thru	P	P				Thru		
	Right						Right		
	Peds						Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		28.0	14.0				35.0		
Yellow		3.0	3.0				3.0		
All Red		0.0	2.0				2.0		

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V		238	239	312	246		159		255			
PHF		0.78	0.78	0.89	0.89		0.85		0.85			
Adj flow		305	235	351	276		187		300			
No. Lanes	0	1	0	1	1	0	0	0	0	0	0	0
Lane group		TR			L T			LR				
Adj flow		540		351	276		487					
Prop LTs		0.000		1.000	0.000		0.384					
Prop RTs		0.435		0.000			0.616					

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound		Westbound		Northbound		Southbound	
LG	TR		L T		LR			
So	1900		1900 1900		1900			
Lanes 0	1	0	1	1 0	0	0 0	0	0 0
fW	1.133		0.967 0.967		0.967			
fHV	0.980		0.962 0.962		0.990			
fG	1.000		1.000 1.000		1.000			
fP	1.000		1.000 1.000		0.875			
fBB	0.992		1.000 1.000		1.000			
fA	1.000		1.000 1.000		1.000			
fLU	1.000		1.000 1.000		1.000			
fRT	0.941		1.000		0.917			
fLT	1.000		0.950 1.000		0.981			
Sec.			0.154					
fLpb	1.000		1.000 1.000		1.000			
fRpb	1.000		1.000		1.000			
S	1971		1678 1766		1431			
Sec.			272					

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Eastbound												
TR	0.88	0.31	29.4	1.000	613	0.50	15.6	0.0	45.0	D	45.0	D
Westbound												
L	0.81	0.50	31.0	1.000	434	0.50	14.8	0.0	45.9	D		
T	0.31	0.50	13.3	1.000	883	0.50	0.9	0.0	14.3	B	32.0	C
Northbound												
LR	0.87	0.39	25.5	1.000	557	0.50	16.6	0.0	42.0	D	42.0	D
Southbound												

Intersection delay = 39.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)		45.0		
Effective permitted green time for LT lane group, g(s)		26.0		
Opposing effective green time, go (s)		28.0		
Number of lanes in LT lane group, N		1		
Number of lanes in opposing approach, No		1		
Adjusted LT flow rate, VLT (veh/h)		351		
Proportion of LT in LT lane group, PLT		1.000		
Proportion of LT in opposing flow, PLTo		0.00		
Adjusted opposing flow rate, Vo (veh/h)		540		
Lost time for LT lane group, tL		5.00		
Computation				
LT volume per cycle, LTC=VLT/C		8.78		
Opposing lane util. factor, fLUo	1.000	1.000		1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)		13.50		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g		0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)		1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]		0.69		
gq, (see Exhibit C16-4,5,6,7,8)		19.19		
gu=g-gq if gq>=gf, or = g-gf if gq<gf		6.81		
n=Max(gq-gf)/2,0)		9.59		
PTHo=1-PLTo		1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]		1.00		
EL1 (refer to Exhibit C16-3)		2.16		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g		0.15		
gdifff=max(gq-gf,0)		0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)		0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT		0.154		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gq>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.384
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Pedestrian flow rate, Vpedg (p/h)				
OCCpedg				
Opposing queue clearing green, gq (s)				
Eff. ped. green consumed by opp. veh. queue, gq/gp				
OCCpedu				
Opposing flow rate, Vo (veh/h)				
OCCr				
Number of cross-street receiving lanes, Nrec				
Number of turning lanes, Nturn				
ApbT				
Proportion of left turns, PLT				
Proportion of left turns using protected phase, PLTA				
Left-turn adjustment, fLpb				
Permitted Right Turns				
Effective pedestrian green time, gp (s)				
Conflicting pedestrian volume, Vped (p/h)				
Conflicting bicycle volume, Vbic (bicycles/h)				
Vpedg				
OCCpedg				
Effective green, g (s)				
Vbicg				

OCCbicg
 OCCr
 Number of cross-street receiving lanes, Nrec
 Number of turning lanes, Nturn
 ApbT
 Proportion right-turns, PRT
 Proportion right-turns using protected phase, PRTA
 Right turn adjustment, fRpb

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v		351		
v/c ratio from Capacity Worksheet, X		0.81		
Protected phase effective green interval, g (s)		19.0		
Opposing queue effective green interval, gq		19.19		
Unopposed green interval, gu		6.81		
Red time r=(C-g-gq-gu)		45.0		
Arrival rate, qa=v/(3600(max[X,1.0]))		0.10		
Protected ph. departure rate, Sp=s/3600		0.466		
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)		0.29		
XPerm		3.52		
XProt				
Case		5		
Queue at beginning of green arrow, Qa		4.96		
Queue at beginning of unsaturated green, Qu		6.26		
Residual queue, Qr		0.00		
Uniform Delay, d1		31.0		

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
TR	0.0	0.00	31.0	29.4	0.00	0.0	0.0	45.0
	0.0						0.0	
Westbound								
L	0.0	0.00		31.0	0.00	0.0	0.0	45.9
T	0.0	0.00	22.5	13.3	0.00	0.0	0.0	14.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LR	0.0	0.00	27.5	25.5	0.00	0.0	0.0	42.0
	0.0						0.0	
Southbound								
	0.0						0.0	
	0.0						0.0	
	0.0						0.0	
Intersection Delay			39.2	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound		
LaneGroup		TR	L	T		LR			
Init Queue		0.0	0.0	0.0		0.0			
Flow Rate		540	351	276		487			
So		1900	1900	1900		1900			
No.Lanes	0	1	0	1	0	0	0	0	0
SL		1971	866	1766		1431			
LnCapacity		613	434	883		557			
Flow Ratio		0.3	0.4	0.2		0.3			
v/c Ratio		0.88	0.81	0.31		0.87			
Grn Ratio		0.31	0.50	0.50		0.39			
I Factor		0.927		0.992		0.953			
AT or PVG		3	3	3		3			
Pltn Ratio		1.00	1.00	1.00		1.00			
PF2		1.00	1.00	1.00		1.00			
Q1		12.8	5.3	4.1		11.3			
kB		0.8	0.6	1.0		0.7			
Q2		3.9	2.2	0.5		3.6			
Q Average		16.7	7.5	4.6		14.8			
Q Spacing		25.0	25.0	25.0		25.0			
Q Storage		0	0	0		0			
Q S Ratio									
70th Percentile Output:									
fB%		1.2	1.2	1.2		1.2			
BOQ		20.1	9.2	5.7		17.9			
QSRatio									
85th Percentile Output:									
fB%		1.4	1.5	1.5		1.4			
BOQ		23.6	11.0	6.9		21.0			
QSRatio									
90th Percentile Output:									
fB%		1.5	1.6	1.7		1.5			
BOQ		25.4	12.1	7.8		22.6			
QSRatio									
95th Percentile Output:									
fB%		1.6	1.8	2.0		1.7			
BOQ		27.3	13.7	9.1		24.5			
QSRatio									
98th Percentile Output:									
fB%		1.8	2.0	2.3		1.8			
BOQ		29.3	15.2	10.5		26.4			
QSRatio									

ERROR MESSAGES

No errors to report.

Alternative 3

With-Action

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	3	6	1	277	34	220	0	216	297	108	166	9
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0					25.0		
Yellow		3.0					3.0		
All Red		2.0					2.0		

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	708	1700	0.02	0.42	10.3	B	10.3	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	530	1273	0.67	0.42	20.5	C	18.6	B
R	514	1233	0.49	0.42	16.0	B		

Northbound

LTR	712	1708	0.85	0.42	26.5	C	26.5	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	322	773	1.01	0.42	70.0	E	70.0	E
-----	-----	-----	------	------	------	---	------	---

Intersection Delay = 32.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	277	34	220	0	216	297	108	166	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	80	10	63	0	64	87	31	48	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		11			357	253		603			325	
%InSharedLn												
Prop LTs		0.273			0.891			0.000			0.382	
Prop RTs		0.091			0.000	1.000		0.579			0.031	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4			3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	277	34	220	0	216	297	108	166	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	318	39	253	0	254	349	124	191	10
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	11			357 253			603			325		
Prop LTs	0.273			0.891			0.000			0.382		
Prop RTs	0.091			0.000 1.000			0.579			0.031		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.990			0.935 0.935			0.901			0.901		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.984			0.988		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.988			1.000 0.850			0.922			0.996		
fLT	0.937			0.741			1.000			0.405		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1700			1273 1233			1708			773		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1700	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	357	1273	# 0.28	0.42	530	0.67
Right	R	253	1233	0.21	0.42	514	0.49
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1708	0.35	0.42	712	0.85
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	325	773	# 0.42	0.42	322	1.01
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B	
Westbound													
LT	0.67	0.42	14.2	1.000	530	0.50	6.3	0.0	20.5	C	18.6	B	
R	0.49	0.42	12.8	1.000	514	0.50	3.1	0.0	16.0	B			
Northbound													
LTR	0.85	0.42	15.8	1.000	712	0.50	10.7	0.0	26.5	C	26.5	C	
Southbound													
LTR	1.01	0.42	17.5	1.000	322	0.50	52.5	0.0	70.0	E	70.0	E	

Intersection delay = 32.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				

Computation

LT volume per cycle, LTC=VLT/3600

Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
----------------------------------	-------	-------	-------	-------

Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)

gf=G[exp(- a * (LTC * b))]-tL, gf<=g

Opposing platoon ratio, Rpo (refer Exhibit 16-11)

Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]

gq, (see Exhibit C16-4,5,6,7,8)

gu=g-gq if gq>=gf, or = g-gf if gq<gf

n=Max(gq-gf)/2,0)

PTHo=1-PLTo

PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]

EL1 (refer to Exhibit C16-3)

EL2=Max((1-Ptho**n)/Plto, 1.0)

fmin=2(1+PL)/g or fmin=2(1+PL)/g

gdifff=max(gq-gf,0)

fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)

flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)

or flt=[fm+0.91(N-1)]/N**

Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	3	318	0	124
Proportion of LT in LT lane group, PLT	0.273	0.891	0.000	0.382
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.38	0.00
Adjusted opposing flow rate, Vo (veh/h)	357	11	325	603
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.30	0.00	2.07
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.95	0.18	5.42	10.05
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	1.4
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.86	0.00	5.11	11.19
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	19.89	13.81
n=Max(gq-gf)/2,0)	0.00	0.00	2.55	4.88
PTHo=1-PLTo	0.11	0.73	0.62	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	0.38
EL1 (refer to Exhibit C16-3)	1.99	1.39	1.93	2.54
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.85	
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	0.11
gdif=max(gq-gf,0)	0.00	0.00	5.11	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	1.00	0.40
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdif/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.937	0.741	1.000	0.405

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.86			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.234			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	357			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.2	0.00	0.0	0.0	20.5
R	0.0	0.00	17.5	12.8	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.8	0.00	0.0	0.0	26.5
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	0.8	0.0	70.0
	0.0						0.0	
Intersection Delay			32.4	sec/veh	Intersection LOS		C	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		LTR		
Init Queue	0.0			0.0	0.0	0.0		0.0		
Flow Rate	11			357	253	603		325		
So	1900			1900	1900	1900		1900		
No.Lanes	0	1	0	0	1	1	0	1	0	0
SL	1700			1273	1233	1708		773		
LnCapacity	708			530	514	712		322		
Flow Ratio	0.0			0.3	0.2	0.4		0.4		
v/c Ratio	0.02			0.67	0.49	0.85		1.01		
Grn Ratio	0.42			0.42	0.42	0.42		0.42		
I Factor	1.000			0.940		0.887		1.000		
AT or PVG	3			3	3	3		3		
Pltn Ratio	1.00			1.00	1.00	1.00		1.00		
PF2	1.00			1.00	1.00	1.00		1.00		
Q1	0.1			4.8	3.1	9.1		5.4		
kB	0.7			0.5	0.5	0.6		0.4		
Q2	0.0			1.0	0.5	2.8		4.2		
Q Average	0.1			5.8	3.6	11.8		9.6		
Q Spacing	25.0			25.0	25.0	25.0		25.0		
Q Storage	0			0	0	0		0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2		
BOQ	0.2			7.2	4.5	14.3		11.6		
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.5	1.4		1.4		
BOQ	0.2			8.7	5.5	16.9		13.8		
QSRatio										
90th Percentile Output:										
fB%	2.0			1.7	1.7	1.5		1.6		
BOQ	0.2			9.7	6.2	18.3		15.1		
QSRatio										
95th Percentile Output:										
fB%	2.6			1.9	2.1	1.7		1.7		
BOQ	0.3			11.2	7.5	20.0		16.7		
QSRatio										
98th Percentile Output:										
fB%	3.2			2.2	2.4	1.8		1.9		
BOQ	0.4			12.7	8.7	21.8		18.4		
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 With-Action Alt 3
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	49	183	169	203	441	79	107	251	74	68	31	27
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	577	0.29	0.33	25.1	C		
TR	582	1746	0.61	0.33	28.9	C	28.4	C
Westbound								
L	201	604	1.16	0.33	142.3	F		
TR	1092	3277	0.54	0.33	26.3	C	59.0	E
Northbound								
LTR	910	3277	0.51	0.28	29.4	C	29.4	C
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	356	1602	0.24	0.22	30.4	C	30.5	C

Intersection Delay = 42.2 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	49	183	169	203	441	79	107	251	74	68	31	27
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	14	52	48	58	127	23	29	67	20	25	12	10
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	56	357		233	593			465		101	86	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.247			0.000	
Prop RTs		0.417			0.145			0.172			0.465	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.780			0.979		1.000				0.991	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	49	183	169	203	441	79	107	251	74	68	31	27
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	56	208	149	233	507	86	115	270	80	101	46	40
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	56	357		233	593			465		101	86	
Prop LTs	1.000	0.000		1.000	0.000			0.247			0.000	
Prop RTs		0.417			0.145			0.172			0.465	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.980	0.980		0.926	0.926			0.926		0.971	0.971	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.937			0.978			0.974			0.930	
fLT	0.321	1.000		0.368	1.000			0.988		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	577	1746		604	3277			3277		1694	1602	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	56	577	0.10	0.33	192	0.29
Prot							
Perm							
Thru	TR	357	1746	0.20	0.33	582	0.61
Right							
Westbound							
Prot							
Perm							
Left	L	233	604	# 0.39	0.33	201	1.16
Prot							
Perm							
Thru	TR	593	3277	0.18	0.33	1092	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	465	3277	# 0.14	0.28	910	0.51
Right							
Southbound							
Prot							
Perm							
Left	L	101	1694	# 0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	86	1602	0.05	0.22	356	0.24
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.59
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.70

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.29	0.33	22.2	1.000	192	0.50	3.0	0.0	25.1	C			
TR	0.61	0.33	25.1	1.000	582	0.50	3.7	0.0	28.9	C	28.4	C	
Westbound													
L	1.16	0.33	30.0	1.000	201	0.50	112.3	0.0	142.3	F			
TR	0.54	0.33	24.4	1.000	1092	0.50	1.9	0.0	26.3	C	59.0	E	
Northbound													
LTR	0.51	0.28	27.4	1.000	910	0.50	2.0	0.0	29.4	C	29.4	C	
Southbound													
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C			
TR	0.24	0.22	28.8	1.000	356	0.50	1.6	0.0	30.4	C	30.5	C	

Intersection delay = 42.2 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	56	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	593	357		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.40	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.79	8.93		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.55	9.84		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.45	20.16		
n=Max(gq-gf)/2,0)	3.78	4.92		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.33	1.83		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.37		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.321	0.368		

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$. For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.247 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.55			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.252			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	593			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.145
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	22.2	0.00	0.0	0.0	25.1
TR	0.0	0.00	30.0	25.1	0.00	0.0	0.0	28.9
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	8.0	0.0	142.3
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	27.4	0.00	0.0	0.0	29.4
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	28.8	0.00	0.0	0.0	30.4
	0.0						0.0	

Intersection Delay	42.2	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	56	357		233	311		244			101	86	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	577	1746		604	1721		1721			1694	1602	
LnCapacity	192	582		201	573		477			376	356	
Flow Ratio	0.1	0.2		0.4	0.2		0.1			0.1	0.1	
v/c Ratio	0.29	0.61		1.16	0.54		0.51			0.27	0.24	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.780			0.979		1.000				0.991	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	1.0	7.5		5.8	6.3		5.1			2.1	1.8	
kB	0.3	0.6		0.4	0.8		0.7			0.6	0.5	
Q2	0.1	0.9		5.8	0.9		0.7			0.2	0.2	
Q Average	1.1	8.4		11.6	7.2		5.8			2.3	1.9	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.3	1.3	
BOQ	1.5	10.3		14.1	8.8		7.2			2.9	2.5	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.5		1.4	1.5		1.5			1.6	1.6	
BOQ	1.9	12.3		16.6	10.6		8.7			3.7	3.1	
QSRatio												
90th Percentile Output:												
fB%	1.9	1.6		1.5	1.6		1.7			1.8	1.8	
BOQ	2.2	13.4		18.0	11.7		9.7			4.2	3.6	
QSRatio												
95th Percentile Output:												
fB%	2.4	1.8		1.7	1.8		1.9			2.2	2.3	
BOQ	2.8	15.0		19.8	13.2		11.1			5.1	4.4	
QSRatio												
98th Percentile Output:												
fB%	2.9	2.0		1.8	2.1		2.2			2.6	2.7	
BOQ	3.3	16.7		21.5	14.8		12.6			6.1	5.3	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						404		
Peak-Hour Factor, PHF						0.95		
Hourly Flow Rate, HFR						425		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		178						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		191						
Percent Heavy Vehicles		8						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage				/		/		
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			191						
C(m) (vph)			575						
v/c			0.33						
95% queue length			1.45						
Control Delay			14.3						
LOS			B						
Approach Delay				14.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 404
 Peak-Hour Factor, PHF 0.95
 Peak-15 Minute Volume 106
 Hourly Flow Rate, HFR 425
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 178
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 48
 Hourly Flow Rate, HFR 191
 Percent Heavy Vehicles 8
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			8					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.5					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			8					
t(f)			3.6					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			425					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	425	
Potential Capacity	575	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	575	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 425
Potential Capacity 575
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 575

Results for Two-stage process:
a
y
C t 575

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	191					
Movement Capacity (vph)	575					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	575					
Volume	191					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			191					
C(m) (vph)			575					
v/c			0.33					
95% queue length			1.45					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	17	6	276	24	370	1	199	259	211	214	1
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	713	1711	0.04	0.42	10.5	B	10.5	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	522	1253	0.64	0.42	19.2	B	22.9	C
R	518	1244	0.79	0.42	25.9	C		

Northbound

LTR	715	1717	0.70	0.42	19.6	B	19.6	B
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	430	1033	1.15	0.42	109.2	F	109.2	F
-----	-----	------	------	------	-------	---	-------	---

Intersection Delay = 45.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	276	24	370	1	199	259	211	214	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	77	7	103	1	54	70	61	62	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		28			334	411		499			495	
%InSharedLn												
Prop LTs		0.036			0.919			0.002			0.495	
Prop RTs		0.250			0.000	1.000		0.565			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	276	24	370	1	199	259	211	214	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	307	27	411	1	216	282	245	249	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	28			334 411			499			495		
Prop LTs	0.036			0.919			0.002			0.495		
Prop RTs	0.250			0.000 1.000			0.565			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.962			0.943 0.943			0.901			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.984		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.966			1.000 0.850			0.924			1.000		
fLT	0.992			0.723			0.999			0.522		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1711			1253 1244			1717			1033		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1711	0.02	0.42	713	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	334	1253	0.27	0.42	522	0.64
Right	R	411	1244	# 0.33	0.42	518	0.79
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	499	1717	0.29	0.42	715	0.70
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	495	1033	# 0.48	0.42	430	1.15
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.81
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.97

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.04	0.42	10.4	1.000	713	0.50	0.1	0.0	10.5	B	10.5	B
Westbound												
LT	0.64	0.42	13.9	1.000	522	0.50	5.3	0.0	19.2	B	22.9	C
R	0.79	0.42	15.2	1.000	518	0.50	10.6	0.0	25.9	C		
Northbound												
LTR	0.70	0.42	14.4	1.000	715	0.50	5.2	0.0	19.6	B	19.6	B
Southbound												
LTR	1.15	0.42	17.5	1.000	430	0.50	91.7	0.0	109.2	F	109.2	F

Intersection delay = 45.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLTC/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	307	1	245
Proportion of LT in LT lane group, PLT	0.036	0.919	0.002	0.495
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.49	0.00
Adjusted opposing flow rate, Vo (veh/h)	334	28	495	499
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.12	0.02	4.08
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.57	0.47	8.25	8.32
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	18.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	5.32	0.00	8.93	9.02
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	6.58	15.98
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	4.51
PTHo=1-PLTo	0.08	0.96	0.51	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	0.49
EL1 (refer to Exhibit C16-3)	1.95	1.42	2.29	2.30
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	4.49
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	9.02
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	0.52
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.723	0.999	0.522

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.32		8.93	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.213		0.357	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	334		495	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.4	0.00	0.0	0.0	10.5
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	13.9	0.00	0.0	0.0	19.2
R	0.0	0.00	17.5	15.2	0.00	0.0	0.0	25.9
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.4	0.00	0.0	0.0	19.6
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	16.2	0.0	109.2
	0.0						0.0	
Intersection Delay			45.9	sec/veh	Intersection LOS D			

_____BACK OF QUEUE WORKSHEET_____

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LTR		LTR	
Init Queue	0.0		0.0	0.0	0.0		0.0	
Flow Rate	28		334	411	499		495	
So	1900		1900	1900	1900		1900	
No.Lanes	0 1 0	0	1 1	0	1 0	0	1 0	
SL	1711		1253	1244	1717		1033	
LnCapacity	713		522	518	715		430	
Flow Ratio	0.0		0.3	0.3	0.3		0.5	
v/c Ratio	0.04		0.64	0.79	0.70		1.15	
Grn Ratio	0.42		0.42	0.42	0.42		0.42	
I Factor	1.000		0.887		0.931		1.000	
AT or PVG	3		3	3	3		3	
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	
PF2	1.00		1.00	1.00	1.00		1.00	
Q1	0.3		4.4	6.0	6.8		8.3	
kB	0.7		0.5	0.5	0.6		0.5	
Q2	0.0		0.8	1.6	1.4		10.8	
Q Average	0.3		5.3	7.6	8.2		19.1	
Q Spacing	25.0		25.0	25.0	25.0		25.0	
Q Storage	0		0	0	0		0	
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.2		1.2	
BOQ	0.4		6.5	9.3	10.0		23.0	
QSRatio								
85th Percentile Output:								
fB%	1.7		1.5	1.5	1.5		1.4	
BOQ	0.5		7.9	11.2	12.0		26.9	
QSRatio								
90th Percentile Output:								
fB%	2.0		1.7	1.6	1.6		1.5	
BOQ	0.6		8.8	12.3	13.1		28.9	
QSRatio								
95th Percentile Output:								
fB%	2.5		1.9	1.8	1.8		1.6	
BOQ	0.8		10.3	13.8	14.8		31.0	
QSRatio								
98th Percentile Output:								
fB%	3.1		2.2	2.0	2.0		1.7	
BOQ	0.9		11.7	15.4	16.4		33.1	
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM

Agency: AECOM

Date: 7/9/2013

Period: Weekday 12-1 PM MD Peak Period

Project ID: Charleston EIS

E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP

Area Type: All other areas

Jurisd: Staten Island, NY

Year : 2020 With-Action Alt 3

N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LG Config	L	TR		L	TR		LTR			L	TR	
Volume	93	326	152	215	600	84	157	326	223	149	67	40
Lane Width	11.0	12.0		10.0	12.0		12.5			11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25

Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	136	409	0.82	0.33	62.7	E		
TR	602	1805	0.88	0.33	43.3	D	46.6	D
Westbound								
L	86	257	2.78	0.33	859.8	F		
TR	1120	3359	0.67	0.33	28.6	C	230.3	F
Northbound								
LTR	926	3332	0.82	0.28	38.5	D	38.5	D
Southbound								
L	380	1711	0.49	0.22	34.9	C		
TR	365	1641	0.37	0.22	32.4	C	33.9	C

Intersection Delay = 109.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93	326	152	215	600	84	157	326	223	149	67	40
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	28	97	45	60	167	23	42	88	60	47	21	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1900	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	111	531		239	746			760		186	134	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.222			0.000	
Prop RTs		0.269			0.106			0.316			0.373	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.856			0.927		1.000				0.985	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	93	326	152	215	600	84	157	326	223	149	67	40
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	111	388	143	239	667	79	169	351	240	186	84	50
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	111	531		239	746			760		186	134	
Prop LTs	1.000	0.000		1.000	0.000			0.222			0.000	
Prop RTs		0.269			0.106			0.316			0.373	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1900	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000			1.017		0.967	0.933	
fHV	0.990	0.990		0.943	0.943			0.962		0.980	0.980	
fG	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fP	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fBB	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fA	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fLU	1.000	1.000		1.000	0.952			0.952		1.000	1.000	
fRT		0.960			0.984			0.953			0.944	
fLT	0.225	1.000		0.154	1.000			0.989		0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000			1.000		1.000	1.000	
fRpb		1.000			1.000			1.000			1.000	
S	409	1805		257	3359			3332		1711	1641	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	111	409	0.27	0.33	136	0.82
Prot							
Perm							
Thru	TR	531	1805	0.29	0.33	602	0.88
Right							
Westbound							
Prot							
Perm							
Left	L	239	257	# 0.93	0.33	86	2.78
Prot							
Perm							
Thru	TR	746	3359	0.22	0.33	1120	0.67
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	760	3332	# 0.23	0.28	926	0.82
Right							
Southbound							
Prot							
Perm							
Left	L	186	1711	# 0.11	0.22	380	0.49
Prot							
Perm							
Thru	TR	134	1641	0.08	0.22	365	0.37
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.27
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.52

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.82	0.33	27.5	1.000	136	0.50	35.3	0.0	62.7	E		
TR	0.88	0.33	28.3	1.000	602	0.50	14.9	0.0	43.3	D	46.6	D
Westbound												
L	2.78	0.33	30.0	1.000	86	0.50	829.8	0.0	859.8	F		
TR	0.67	0.33	25.7	1.000	1120	0.50	2.9	0.0	28.6	C	230.3	F
Northbound												
LTR	0.82	0.28	30.4	1.000	926	0.50	8.1	0.0	38.5	D	38.5	D
Southbound												
L	0.49	0.22	30.5	1.000	380	0.50	4.4	0.0	34.9	C		
TR	0.37	0.22	29.6	1.000	365	0.50	2.8	0.0	32.4	C	33.9	C

Intersection delay = 109.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	111	239		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	746	531		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLT/C	2.78	5.98		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.80	13.27		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	11.69	20.11		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.31	9.89		
n=Max(gq-gf)/2,0)	5.85	10.05		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.71	2.14		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.15		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.225	0.154		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.222 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, $gro = \text{Max}[1 - Rpo(go/C), 0]$
 gq , (see Exhibit C16-4, 5, 6, 7, 8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 $EL1$ (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, ($min = fmin; max = 1.00$)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, ($fmin \leq fm \leq 1.00$)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	11.69			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.390			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	746			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		30.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	90.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	27.5	0.00	0.0	0.0	62.7
TR	0.0	0.00	30.0	28.3	0.00	0.0	0.0	43.3
	0.0						0.0	
Westbound								
L	0.0	0.00	30.0	30.0	0.00	38.2	0.0	859.8
TR	0.0	0.00	30.0	25.7	0.00	0.0	0.0	28.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	30.4	0.00	0.0	0.0	38.5
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	30.5	0.00	0.0	0.0	34.9
TR	0.0	0.00	35.0	29.6	0.00	0.0	0.0	32.4
	0.0						0.0	

Intersection Delay	109.7	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	111	531		239	391		399			186	134	
So	1900	1900		1900	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	409	1805		257	1764		1749			1711	1641	
LnCapacity	136	602		86	588		486			380	365	
Flow Ratio	0.3	0.3		0.9	0.2		0.2			0.1	0.1	
v/c Ratio	0.82	0.88		2.78	0.66		0.82			0.49	0.37	
Grn Ratio	0.33	0.33		0.33	0.33		0.28			0.22	0.22	
I Factor		0.856			0.927		1.000				0.985	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.5	12.5		6.0	8.4		9.3			4.1	2.8	
kB	0.2	0.7		0.2	0.7		0.7			0.6	0.6	
Q2	0.8	3.6		19.4	1.4		2.6			0.5	0.3	
Q Average	3.4	16.2		25.4	9.7		11.9			4.6	3.2	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.3	1.2		1.2	1.2		1.2			1.2	1.3	
BOQ	4.2	19.5		30.5	11.8		14.4			5.7	4.0	
QSRatio												
85th Percentile Output:												
fB%	1.6	1.4		1.4	1.4		1.4			1.5	1.6	
BOQ	5.3	22.8		35.6	14.1		17.0			7.0	4.9	
QSRatio												
90th Percentile Output:												
fB%	1.8	1.5		1.5	1.6		1.5			1.7	1.8	
BOQ	5.9	24.6		38.2	15.3		18.4			7.8	5.6	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.6		1.6	1.7		1.7			2.0	2.1	
BOQ	7.1	26.5		40.8	17.0		20.1			9.2	6.7	
QSRatio												
98th Percentile Output:												
fB%	2.5	1.8		1.7	1.9		1.8			2.3	2.5	
BOQ	8.3	28.4		43.4	18.6		21.9			10.6	7.9	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound		
		1	2	3	4	5	6	
		L	T	R	L	T	R	
Volume						434		
Peak-Hour Factor, PHF						0.87		
Hourly Flow Rate, HFR						498		
Percent Heavy Vehicles		--	--			--	--	
Median Type/Storage		Undivided		/				
RT Channelized?								
Lanes						1		
Configuration						T		
Upstream Signal?		No				No		

Minor Street:	Approach Movement	Westbound				Eastbound		
		7	8	9	10	11	12	
		L	T	R	L	T	R	
Volume		133						
Peak Hour Factor, PHF		0.93						
Hourly Flow Rate, HFR		143						
Percent Heavy Vehicles		4						
Percent Grade (%)			0			0		
Flared Approach: Exists?/Storage					/		/	
Lanes		1						
Configuration		L						

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			143						
C(m) (vph)			528						
v/c			0.27						
95% queue length			1.09						
Control Delay			14.3						
LOS			B						
Approach Delay				14.3					
Approach LOS				B					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 434
 Peak-Hour Factor, PHF 0.87
 Peak-15 Minute Volume 125
 Hourly Flow Rate, HFR 498
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 133
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 36
 Hourly Flow Rate, HFR 143
 Percent Heavy Vehicles 4
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
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Flow (ped/hr)	0	0	0	0
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Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			4					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			4					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			498					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	498	
Potential Capacity	528	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	528	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 498
Potential Capacity 528
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 528

Results for Two-stage process:
a
y
C t 528

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	143					
Movement Capacity (vph)	528					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	528					
Volume	143					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			143					
C(m) (vph)			528					
v/c			0.27					
95% queue length			1.09					
Control Delay			14.3					
LOS			B					
Approach Delay				14.3				
Approach LOS				B				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	1	11	2	354	20	279	4	207	317	267	284	1
Lane Width	15.5			11.0 10.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1742	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	529	1269	0.86	0.42	31.7	C	26.6	C
R	523	1256	0.65	0.42	19.8	B		

Northbound

LTR	750	1800	0.76	0.42	21.4	C	21.4	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	399	958	1.61	0.42	301.9	F	301.9	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 112.3 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	354	20	279	4	207	317	267	284	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	108	6	85	1	56	85	78	83	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			456	340		568			641	
%InSharedLn												
Prop LTs		0.063			0.947			0.007			0.484	
Prop RTs		0.125			0.000	1.000		0.600			0.002	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		3			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	354	20	279	4	207	317	267	284	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	432	24	340	4	223	341	310	330	1
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			456 340			568			641		
Prop LTs	0.063			0.947			0.007			0.484		
Prop RTs	0.125			0.000 1.000			0.600			0.002		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.971			0.952 0.952			0.952			0.935		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.988			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.983			1.000 0.850			0.919			1.000		
fLT	0.983			0.726			0.996			0.480		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1742			1269 1256			1800			958		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1742	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	456	1269	# 0.36	0.42	529	0.86
Right	R	340	1256	0.27	0.42	523	0.65
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	568	1800	0.32	0.42	750	0.76
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	641	958	# 0.67	0.42	399	1.61
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.03$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.23$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental		Res Del d3	Lane Group		Approach	
	v/c	g/C				k	d2		Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.86	0.42	15.9	1.000	529	0.50	15.8	0.0	31.7	C	26.6	C
R	0.65	0.42	14.0	1.000	523	0.50	5.8	0.0	19.8	B		
Northbound												
LTR	0.76	0.42	14.9	1.000	750	0.50	6.5	0.0	21.4	C	21.4	C
Southbound												
LTR	1.61	0.42	17.5	1.000	399	0.50	284.4	0.0	301.9	F	301.9	F

Intersection delay = 112.3 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	1	432	4	310
Proportion of LT in LT lane group, PLT	0.063	0.947	0.007	0.484
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.48	0.01
Adjusted opposing flow rate, Vo (veh/h)	456	16	641	568
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.20	0.07	5.17
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.60	0.27	10.68	9.47
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	18.9	0.0	16.4	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.09	0.00	11.96	10.47
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.14	25.00	8.62	14.53
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	5.24
PTHo=1-PLTo	0.05	0.94	0.52	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.01	0.48
EL1 (refer to Exhibit C16-3)	2.20	1.40	2.64	2.46
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00	1.00	5.16
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	0.12
gdifff=max(gq-gf,0)	0.00	0.00	0.00	10.47
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	0.48
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.983	0.726	0.996	0.480

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.09		11.96	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.323		0.479	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	456		641	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	25.0		25.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	25.0		25.0
Vbicg	0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.002
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.9	0.00	0.0	0.0	31.7
R	0.0	0.00	17.5	14.0	0.00	0.0	0.0	19.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	14.9	0.00	0.0	0.0	21.4
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	60.5	0.0	301.9
	0.0						0.0	
Intersection Delay			112.3	sec/veh	Intersection LOS		F	

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	LTR			LT	R	LTR		LTR	
Init Queue	0.0			0.0	0.0	0.0		0.0	
Flow Rate	16			456	340	568		641	
So	1900			1900	1900	1900		1900	
No.Lanes	0	1	0	0	1	1	0	1	0
SL	1742			1269	1256	1800		958	
LnCapacity	726			529	523	750		399	
Flow Ratio	0.0			0.4	0.3	0.3		0.7	
v/c Ratio	0.02			0.86	0.65	0.76		1.61	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	
I Factor	1.000			0.933		0.919		1.000	
AT or PVG	3			3	3	3		3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	
PF2	1.00			1.00	1.00	1.00		1.00	
Q1	0.2			6.9	4.5	8.1		10.7	
kB	0.7			0.5	0.5	0.6		0.5	
Q2	0.0			2.5	0.9	1.9		31.4	
Q Average	0.2			9.4	5.4	9.9		42.1	
Q Spacing	25.0			25.0	25.0	25.0		25.0	
Q Storage	0			0	0	0		0	
Q S Ratio									
70th Percentile Output:									
fB%	1.3			1.2	1.2	1.2		1.2	
BOQ	0.2			11.5	6.7	12.1		50.5	
QSRatio									
85th Percentile Output:									
fB%	1.7			1.4	1.5	1.4		1.4	
BOQ	0.3			13.6	8.2	14.3		58.9	
QSRatio									
90th Percentile Output:									
fB%	2.0			1.6	1.7	1.6		1.5	
BOQ	0.3			14.9	9.1	15.6		63.1	
QSRatio									
95th Percentile Output:									
fB%	2.6			1.8	1.9	1.7		1.6	
BOQ	0.4			16.5	10.5	17.3		67.3	
QSRatio									
98th Percentile Output:									
fB%	3.1			1.9	2.2	1.9		1.7	
BOQ	0.5			18.2	12.0	18.9		71.6	
QSRatio									

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM
 Agency: AECOM
 Date: 7/9/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 With-Action Alt 3
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	108	344	210	247	532	87	159	285	150	223	77	56
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	140	420	0.88	0.33	66.6	E		
TR	597	1790	0.97	0.33	53.9	D	56.1	E
Westbound								
L	240	696	1.14	0.34	129.7	F		
TR	1143	3317	0.65	0.34	27.6	C	55.2	E
Northbound								
LTR	946	3406	0.65	0.28	32.0	C	32.0	C
Southbound								
L	384	1728	0.76	0.22	45.8	D		
TR	373	1680	0.38	0.22	32.6	C	41.5	D

Intersection Delay = 48.1 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	108	344	210	247	532	87	159	285	150	223	77	56
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	31	98	60	69	162	27	43	77	40	73	25	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		1950	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	123	579		274	742			611		293	142	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.280			0.000	
Prop RTs		0.325			0.125			0.219			0.289	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.701			0.949		1.000				0.970	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	108	344	210	247	532	87	159	285	150	223	77	56
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	123	391	188	274	649	93	171	306	134	293	101	41
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	123	579		274	742			611		293	142	
Prop LTs	1.000	0.000		1.000	0.000			0.280			0.000	
Prop RTs		0.325			0.125			0.219			0.289	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		1950	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.935	0.935		0.971			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.951			0.981		0.967				0.957	
fLT	0.231	1.000		0.409*	1.000		0.986			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	420	1790		696	3317		3406			1728	1680	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	123	420	0.29	0.33	140	0.88
Prot							
Perm							
Thru	TR	579	1790	0.32	0.33	597	0.97
Right							
Westbound							
Prot							
Perm							
Left	L	274	696	# 0.39	0.34	240	1.14
Prot							
Perm							
Thru	TR	742	3317	0.22	0.34	1143	0.65
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	611	3406	# 0.18	0.28	946	0.65
Right							
Southbound							
Prot							
Perm							
Left	L	293	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	142	1680	0.08	0.22	373	0.38
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 0.74$
Total lost time per cycle, $L = 14.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 0.88$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.88	0.33	28.3	1.000	140	0.50	38.3	0.0	66.6	E		
TR	0.97	0.33	29.6	1.000	597	0.50	24.3	0.0	53.9	D	56.1	E
Westbound												
L	1.14	0.34	29.5	1.000	240	0.50	100.2	0.0	129.7	F		
TR	0.65	0.34	24.9	1.000	1143	0.50	2.7	0.0	27.6	C	55.2	E
Northbound												
LTR	0.65	0.28	28.6	1.000	946	0.50	3.4	0.0	32.0	C	32.0	C
Southbound												
L	0.76	0.22	32.8	1.000	384	0.50	13.0	0.0	45.8	D		
TR	0.38	0.22	29.7	1.000	373	0.50	2.8	0.0	32.6	C	41.5	D

Intersection delay = 48.1 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	31.0		
Opposing effective green time, go (s)	31.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	123	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	742	579		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLT/C	3.08	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.74	14.48		
gf=G[exp(- a * (LTC * b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.66	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	11.30	24.45		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	18.70	6.55		
n=Max(gq-gf)/2,0)	5.65	12.23		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.70	2.24		
EL2=Max((1-Ptho*n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.23	0.13		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.231	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If PL>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm. For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.280 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	11.30			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.377			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	742			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	28.3	0.00	0.0	0.0	66.6
TR	0.0	0.00	30.0	29.6	0.00	0.0	0.0	53.9
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	8.5	0.0	129.7
TR	0.0	0.00	29.5	24.9	0.00	0.0	0.0	27.6
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	28.6	0.00	0.0	0.0	32.0
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.8
TR	0.0	0.00	35.0	29.7	0.00	0.0	0.0	32.6
	0.0						0.0	

Intersection Delay	48.1	sec/veh	Intersection LOS	D
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_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	123	579		274	389		320			293	142	
So	1900	1900		1950	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	420	1790		696	1742		1788			1728	1680	
LnCapacity	140	597		240	600		496			384	373	
Flow Ratio	0.3	0.3		0.4	0.2		0.2			0.2	0.1	
v/c Ratio	0.88	0.97		1.14	0.65		0.65			0.76	0.38	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.701			0.949		1.000				0.970	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.9	14.3		6.8	8.2		7.0			6.9	3.0	
kB	0.2	0.6		0.4	0.8		0.7			0.6	0.6	
Q2	1.0	5.3		6.4	1.3		1.2			1.6	0.3	
Q Average	3.9	19.6		13.2	9.5		8.2			8.5	3.4	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.3	
BOQ	4.9	23.5		16.0	11.6		10.1			10.3	4.2	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.4		1.5			1.5	1.6	
BOQ	6.0	27.5		18.8	13.8		12.0			12.3	5.2	
QSRatio												
90th Percentile Output:												
fB%	1.7	1.5		1.5	1.6		1.6			1.6	1.8	
BOQ	6.7	29.6		20.3	15.0		13.2			13.5	5.9	
QSRatio												
95th Percentile Output:												
fB%	2.1	1.6		1.7	1.7		1.8			1.8	2.1	
BOQ	8.0	31.7		22.1	16.7		14.8			15.1	7.1	
QSRatio												
98th Percentile Output:												
fB%	2.4	1.7		1.8	1.9		2.0			2.0	2.5	
BOQ	9.3	33.9		23.9	18.3		16.4			16.7	8.3	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3		4	5	6	
		L	T	R		L	T	R	
Volume								534	
Peak-Hour Factor, PHF								0.89	
Hourly Flow Rate, HFR								600	
Percent Heavy Vehicles		--		--			--	--	
Median Type/Storage		Undivided			/				
RT Channelized?									
Lanes								1	
Configuration								T	
Upstream Signal?		No						No	
Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9		10	11	12	
		L	T	R		L	T	R	
Volume		407							
Peak Hour Factor, PHF		0.93							
Hourly Flow Rate, HFR		437							
Percent Heavy Vehicles		3							
Percent Grade (%)			0					0	
Flared Approach: Exists?/Storage					/			/	
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound		
	1	4	7	8	9	10	11	12	
Lane Config			L						
v (vph)			437						
C(m) (vph)			462						
v/c			0.95						
95% queue length			11.33						
Control Delay			59.5						
LOS			F						
Approach Delay				59.5					
Approach LOS				F					

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS

Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1	2	3	4	5	6
	L	T	R	L	T	R

Volume 534
 Peak-Hour Factor, PHF 0.89
 Peak-15 Minute Volume 150
 Hourly Flow Rate, HFR 600
 Percent Heavy Vehicles -- --
 Median Type/Storage Undivided /
 RT Channelized?
 Lanes 1
 Configuration T
 Upstream Signal? No

Minor Street Movements	7	8	9	10	11	12
	L	T	R	L	T	R

Volume 407
 Peak Hour Factor, PHF 0.93
 Peak-15 Minute Volume 109
 Hourly Flow Rate, HFR 437
 Percent Heavy Vehicles 3
 Percent Grade (%) 0 0
 Flared Approach: Exists?/Storage / /
 RT Channelized?
 Lanes 1
 Configuration L

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
-----------	----	----	----	----

Flow (ped/hr) 0 0 0 0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			3					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			3					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			600					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
-------------------	---	---	----	----

	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	600	
Potential Capacity	462	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	462	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 600
Potential Capacity 462
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 462

Results for Two-stage process:
a
y
C t 462

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	437					
Movement Capacity (vph)	462					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	462					
Volume	437					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			437					
C(m) (vph)			462					
v/c			0.95					
95% queue length			11.33					
Control Delay			59.5					
LOS			F					
Approach Delay				59.5				
Approach LOS				F				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Alt 3 With-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig	LTR			LT R			LTR			LTR		
Volume	0	10	5	399	27	407	5	251	385	265	260	0
Lane Width	15.5			11.0			15.0			16.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	726	1743	0.02	0.42	10.4	B	10.4	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	546	1311	0.85	0.42	28.9	C	27.9	C
R	539	1293	0.82	0.42	26.8	C		

Northbound

LTR	753	1807	0.93	0.42	34.9	C	34.9	C
-----	-----	------	------	------	------	---	------	---

Southbound

LTR	335	803	1.72	0.42	354.9	F	354.9	F
-----	-----	-----	------	------	-------	---	-------	---

Intersection Delay = 115.7 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
Agency/Co.: AECOM
Date Performed: 7/9/2013
Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
Intersection: Veterans Rd W & Arthur Kill Rd
Area Type: All other areas
Jurisdiction: Staten Island, NY
Analysis Year: 2020 Alt 3 With-Action Cond
Project ID: Charleston EIS
E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	399	27	407	5	251	385	265	260	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	108	7	111	2	69	106	73	71	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900			1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
LGConfig		LTR			LT	R		LTR			LTR	
Lane Width		15.5			11.0	10.0		15.0			16.0	
RTOR Vol			0			0			0			0
Adj Flow		16			463	442		704			577	
%InSharedLn												
Prop LTs		0.000			0.937			0.007			0.504	
Prop RTs		0.313			0.000	1.000		0.601			0.000	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		2			2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0			0.0	
Arriv. Type		3			3	3		3			3	
Unit Ext.		3.0			3.0	3.0		3.0			3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0			2.0	
Ext of g		2.0			2.0	2.0		2.0			2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds	X	
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		25.0						25.0	
Yellow		3.0						3.0	
All Red		2.0						2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	399	27	407	5	251	385	265	260	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	434	29	442	5	276	423	291	286	0
No. Lanes	0	1	0	0	1	1	0	1	0	0	1	0
Lane group	LTR			LT R			LTR			LTR		
Adj flow	16			463 442			704			577		
Prop LTs	0.000			0.937			0.007			0.504		
Prop RTs	0.313			0.000 1.000			0.601			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			LTR		
So	1900			1900 1900			1900			1900		
Lanes 0	1	0	0	1	1	0	1	0	0	1	0	0
fW	1.117			0.967 0.933			1.100			1.133		
fHV	0.980			0.980 0.980			0.952			0.971		
fG	1.000			1.000 1.000			1.000			1.000		
fP	0.875			1.000 0.875			1.000			1.000		
fBB	1.000			1.000 1.000			0.992			0.992		
fA	1.000			1.000 1.000			1.000			1.000		
fLU	1.000			1.000 1.000			1.000			1.000		
fRT	0.958			1.000 0.850			0.919			1.000		
fLT	1.000			0.728			0.996			0.387		
Sec.												
fLpb	1.000			1.000			1.000			1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1311 1293			1807			803		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Capacity (c)	Group-- v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.42	726	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	463	1311	# 0.35	0.42	546	0.85
Right	R	442	1293	0.34	0.42	539	0.82
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	704	1807	0.39	0.42	753	0.93
Right							
Southbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	577	803	# 0.72	0.42	335	1.72
Right							

Sum of flow ratios for critical lane groups, $Y_c = \text{Sum (v/s)} = 1.07$
Total lost time per cycle, $L = 10.00 \text{ sec}$
Critical flow rate to capacity ratio, $X_c = (Y_c)(C)/(C-L) = 1.29$

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	726	0.50	0.1	0.0	10.4	B	10.4	B
Westbound												
LT	0.85	0.42	15.8	1.000	546	0.50	13.1	0.0	28.9	C	27.9	C
R	0.82	0.42	15.5	1.000	539	0.50	11.3	0.0	26.8	C		
Northbound												
LTR	0.93	0.42	16.7	1.000	753	0.50	18.2	0.0	34.9	C	34.9	C
Southbound												
LTR	1.72	0.42	17.5	1.000	335	0.50	337.4	0.0	354.9	F	354.9	F

Intersection delay = 115.7 (sec/veh) Intersection LOS = F

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				
Number of lanes in opposing approach, No				
Adjusted LT flow rate, VLT (veh/h)				
Proportion of LT in LT lane group, PLT				
Proportion of LT in opposing flow, PLTo				
Adjusted opposing flow rate, Vo (veh/h)				
Lost time for LT lane group, tL				
Computation				
LT volume per cycle, LTC=VLT/3600				
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g				
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				
gq, (see Exhibit C16-4,5,6,7,8)				
gu=g-gq if gq>=gf, or = g-gf if gq<gf				
n=Max(gq-gf)/2,0)				
PTHo=1-PLTo				
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				
EL1 (refer to Exhibit C16-3)				
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				
gdifff=max(gq-gf,0)				
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				

For special case of single-lane approach opposed by multilane approach,
see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
For special case of multilane approach opposed by single-lane approach
or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	60.0			
sec				
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	25.0
Opposing effective green time, go (s)	25.0	25.0	25.0	25.0
Number of lanes in LT lane group, N	1	1	1	1

Number of lanes in opposing approach, No	1	1	1	1
Adjusted LT flow rate, VLT (veh/h)	0	434	5	291
Proportion of LT in LT lane group, PLT	0.000	0.937	0.007	0.504
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.50	0.01
Adjusted opposing flow rate, Vo (veh/h)	463	16	577	704
Lost time for LT lane group, tL	5.00	5.00	5.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.23	0.08	4.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.72	0.27	9.62	11.73
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	15.9	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	0.58
gq, (see Exhibit C16-4,5,6,7,8)	8.24	0.00	10.66	13.22
gu=g-gq if gq>=gf, or = g-gf if gq<gf	16.76	25.00	9.12	11.78
n=Max(gq-gf)/2,0)	4.12	0.00	0.00	6.61
PTHo=1-PLTo	0.06	1.00	0.50	0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	0.50
EL1 (refer to Exhibit C16-3)	2.22	1.40	2.48	2.81
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07		1.00	6.48
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.08	0.15	0.08	0.12
gdifff=max(gq-gf,0)	8.24	0.00	0.00	13.22
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.67	0.73	1.00	0.39
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.728	0.996	0.387

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0		25.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.24		10.66	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.330		0.426	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	463		577	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		25.0		25.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		25.0		25.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

_____SUPPLEMENTAL UNIFORM DELAY WORKSHEET_____

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

_____DELAY/LOS WORKSHEET WITH INITIAL QUEUE_____

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.4
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	15.8	0.00	0.0	0.0	28.9
R	0.0	0.00	17.5	15.5	0.00	0.0	0.0	26.8
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	16.7	0.00	0.0	0.0	34.9
	0.0						0.0	
Southbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	17.5	0.00	60.5	0.0	354.9
	0.0						0.0	
Intersection Delay			115.7	sec/veh	Intersection LOS		F	

_____BACK OF QUEUE WORKSHEET_____

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		LTR		
Init Queue	0.0			0.0	0.0	0.0		0.0		
Flow Rate	16			463	442	704		577		
So	1900			1900	1900	1900		1900		
No.Lanes	0	1	0	0	1	1	0	1	0	0
SL	1743			1311	1293	1807		803		
LnCapacity	726			546	539	753		335		
Flow Ratio	0.0			0.4	0.3	0.4		0.7		
v/c Ratio	0.02			0.85	0.82	0.93		1.72		
Grn Ratio	0.42			0.42	0.42	0.42		0.42		
I Factor	1.000			0.849		0.861		1.000		
AT or PVG	3			3	3	3		3		
Pltn Ratio	1.00			1.00	1.00	1.00		1.00		
PF2	1.00			1.00	1.00	1.00		1.00		
Q1	0.2			7.0	6.5	11.2		9.6		
kB	0.7			0.5	0.5	0.6		0.4		
Q2	0.0			2.2	1.9	4.9		31.2		
Q Average	0.2			9.2	8.4	16.1		40.8		
Q Spacing	25.0			25.0	25.0	25.0		25.0		
Q Storage	0			0	0	0		0		
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2		
BOQ	0.2			11.1	10.2	19.4		49.0		
QSRatio										
85th Percentile Output:										
fB%	1.7			1.4	1.5	1.4		1.4		
BOQ	0.3			13.3	12.2	22.7		57.1		
QSRatio										
90th Percentile Output:										
fB%	2.0			1.6	1.6	1.5		1.5		
BOQ	0.3			14.5	13.4	24.4		61.2		
QSRatio										
95th Percentile Output:										
fB%	2.6			1.8	1.8	1.6		1.6		
BOQ	0.4			16.1	15.0	26.4		65.3		
QSRatio										
98th Percentile Output:										
fB%	3.1			1.9	2.0	1.8		1.7		
BOQ	0.5			17.8	16.6	28.3		69.4		
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 7/9/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 With-Action Alt 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR		LTR			L	TR	
Volume	99	428	227	272	679	102	232	479	221	243	140	92
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	81	242	1.31	0.33	217.7	F		
TR	599	1798	1.09	0.33	87.7	F	105.9	F
Westbound								
L	83	240	3.41	0.34	1141	F		
TR	1188	3450	0.83	0.34	33.3	C	279.9	F
Northbound								
LTR	964	3469	1.07	0.28	83.7	F	83.7	F
Southbound								
L	384	1728	0.75	0.22	43.8	D		
TR	367	1651	0.75	0.22	44.4	D	44.1	D

Intersection Delay = 150.9 (sec/veh) Intersection LOS = F

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	99	428	227	272	679	102	232	479	221	243	140	92
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	27	115	61	71	218	33	64	133	61	72	42	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900		2050	1900			1900		1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
LGConfig	L	TR		L	TR			LTR		L	TR	
Lane Width	11.0	12.0		10.0	12.0			12.5		11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	106	652		283	988			1036		289	277	
%InSharedLn												
Prop LTs	1.000	0.000		1.000	0.000			0.249			0.000	
Prop RTs		0.294			0.118			0.237			0.397	
Peds Bikes	0			0		0	0			0		
Buses	0	0		0	0		0			0	0	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Arriv. Type	3	3		3	3		3			3	3	
Unit Ext.	3.0	3.0		3.0	3.0		3.0			3.0	3.0	
I Factor		0.700			0.903		1.000				0.855	
Lost Time	2.0	2.0		2.0	2.0		2.0			2.0	2.0	
Ext of g	2.0	2.0		3.0	3.0		2.0			2.0	2.0	
Ped Min g		34.6			18.6		20.3				16.1	

PHASE DATA

Phase Combination 1			2	3	4	5	6	7	8
EB	Left	P				NB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds						Peds		
WB	Left	P				SB	Left	P	
	Thru	P					Thru	P	
	Right	P					Right	P	
	Peds	X					Peds		
NB	Right					EB	Right		
SB	Right					WB	Right		
Green		30.0						25.0	20.0
Yellow		3.0						3.0	3.0
All Red		2.0						2.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	99	428	227	272	679	102	232	479	221	243	140	92
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	106	460	192	283	871	117	258	532	246	289	167	110
No. Lanes	1	1	0	1	2	0	0	2	0	1	1	0
Lane group	L	TR		L	TR			LTR		L	TR	
Adj flow	106	652		283	988			1036		289	277	
Prop LTs	1.000	0.000		1.000	0.000			0.249			0.000	
Prop RTs		0.294			0.118			0.237			0.397	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	TR		L	TR		L	TR		L	TR	
So	1900	1900		2050	1900		1900			1900	1900	
Lanes	1	1	0	1	2	0	0	2	0	1	1	0
fW	0.967	1.000		0.933	1.000		1.017			0.967	0.933	
fHV	0.990	0.990		0.971	0.971		0.990			0.990	0.990	
fG	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fP	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fBB	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fA	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fLU	1.000	1.000		1.000	0.952		0.952			1.000	1.000	
fRT		0.956			0.982		0.964				0.940	
fLT	0.133	1.000		0.129	1.000		0.988			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000			1.000		1.000				1.000	
S	242	1798		240	3450		3469			1728	1651	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	106	242	0.44	0.33	81	1.31
Prot							
Perm							
Thru	TR	652	1798	0.36	0.33	599	1.09
Right							
Westbound							
Prot							
Perm							
Left	L	283	240	# 1.18	0.34	83	3.41
Prot							
Perm							
Thru	TR	988	3450	0.29	0.34	1188	0.83
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	1036	3469	# 0.30	0.28	964	1.07
Right							
Southbound							
Prot							
Perm							
Left	L	289	1728	0.17	0.22	384	0.75
Prot							
Perm							
Thru	TR	277	1651	# 0.17	0.22	367	0.75
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 1.65
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.95

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	1.31	0.33	30.0	1.000	81	0.50	187.7	0.0	217.7	F			
TR	1.09	0.33	30.0	1.000	599	0.50	57.7	0.0	87.7	F	105.9	F	
Westbound													
L	3.41	0.34	29.5	1.000	83	0.50	1111	0.0	1141	F			
TR	0.83	0.34	27.1	1.000	1188	0.50	6.2	0.0	33.3	C	279.9	F	
Northbound													
LTR	1.07	0.28	32.5	1.000	964	0.50	51.2	0.0	83.7	F	83.7	F	
Southbound													
L	0.75	0.22	32.7	1.000	384	0.50	11.1	0.0	43.8	D			
TR	0.75	0.22	32.7	1.000	367	0.50	11.7	0.0	44.4	D	44.1	D	

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.249 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + Pl) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^*$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

- * If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
- For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	18.90			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.630			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	988			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		30.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		31.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.118
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	30.0	30.0	0.00	6.3	0.0	217.7
TR	0.0	0.00	30.0	30.0	0.00	13.3	0.0	87.7
	0.0						0.0	
Westbound								
L	0.0	0.00	29.5	29.5	0.00	50.0	0.0	1141
TR	0.0	0.00	29.5	27.1	0.00	0.0	0.0	33.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LTR	0.0	0.00	32.5	32.5	0.00	18.0	0.0	83.7
	0.0						0.0	
Southbound								
L	0.0	0.00	35.0	32.7	0.00	0.0	0.0	43.8
TR	0.0	0.00	35.0	32.7	0.00	0.0	0.0	44.4
	0.0						0.0	

Intersection Delay	150.9	sec/veh	Intersection LOS	F
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound			Southbound		
LaneGroup	L	TR		L	TR		LTR			L	TR	
Init Queue	0.0	0.0		0.0	0.0		0.0			0.0	0.0	
Flow Rate	106	652		283	518		544			289	277	
So	1900	1900		2050	1900		1900			1900	1900	
No.Lanes	1	1	0	1	2	0	0	2	0	1	1	0
SL	242	1798		240	1811		1821			1728	1651	
LnCapacity	81	599		83	623		506			384	367	
Flow Ratio	0.4	0.4		1.2	0.3		0.3			0.2	0.2	
v/c Ratio	1.31	1.09		3.41	0.83		1.08			0.75	0.75	
Grn Ratio	0.33	0.33		0.34	0.34		0.28			0.22	0.22	
I Factor		0.700			0.903		1.000				0.855	
AT or PVG	3	3		3	3		3			3	3	
Pltn Ratio	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
PF2	1.00	1.00		1.00	1.00		1.00			1.00	1.00	
Q1	2.7	16.3		7.1	11.9		13.6			6.7	6.5	
kB	0.1	0.6		0.2	0.7		0.7			0.5	0.5	
Q2	3.6	10.8		25.3	3.0		9.7			1.4	1.3	
Q Average	6.3	27.1		32.3	14.9		23.3			8.1	7.8	
Q Spacing	25.0	25.0		25.0	25.0		25.0			25.0	25.0	
Q Storage	0	0		0	0		0			0	0	
Q S Ratio												
70th Percentile Output:												
fB%	1.2	1.2		1.2	1.2		1.2			1.2	1.2	
BOQ	7.7	32.6		38.8	17.9		28.0			9.9	9.5	
QSRatio												
85th Percentile Output:												
fB%	1.5	1.4		1.4	1.4		1.4			1.5	1.5	
BOQ	9.3	38.0		45.3	21.1		32.7			11.8	11.4	
QSRatio												
90th Percentile Output:												
fB%	1.6	1.5		1.5	1.5		1.5			1.6	1.6	
BOQ	10.3	40.8		48.5	22.7		35.1			13.0	12.5	
QSRatio												
95th Percentile Output:												
fB%	1.9	1.6		1.6	1.7		1.6			1.8	1.8	
BOQ	11.8	43.5		51.8	24.6		37.5			14.6	14.1	
QSRatio												
98th Percentile Output:												
fB%	2.1	1.7		1.7	1.8		1.7			2.0	2.0	
BOQ	13.4	46.3		55.0	26.4		40.0			16.2	15.7	
QSRatio												

ERROR MESSAGES

No errors to report.

TWO-WAY STOP CONTROL SUMMARY

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street:	Approach Movement	Northbound				Southbound			
		1	2	3	4	5	6		
		L	T	R	L	T	R		
Volume						637			
Peak-Hour Factor, PHF						0.93			
Hourly Flow Rate, HFR						684			
Percent Heavy Vehicles		--	--			--	--		
Median Type/Storage		Undivided		/					
RT Channelized?									
Lanes						1			
Configuration						T			
Upstream Signal?		No				No			

Minor Street:	Approach Movement	Westbound				Eastbound			
		7	8	9	10	11	12		
		L	T	R	L	T	R		
Volume		178							
Peak Hour Factor, PHF		0.90							
Hourly Flow Rate, HFR		197							
Percent Heavy Vehicles		1							
Percent Grade (%)			0			0			
Flared Approach: Exists?/Storage					/		/		
Lanes		1							
Configuration		L							

Delay, Queue Length, and Level of Service

Approach Movement	NB	SB	Westbound				Eastbound			
	1	4	7	8	9	10	11	12		
Lane Config			L							
v (vph)			197							
C(m) (vph)			416							
v/c			0.47							
95% queue length			2.47							
Control Delay			21.2							
LOS			C							
Approach Delay				21.2						
Approach LOS				C						

HCS+: Unsignalized Intersections Release 5.4

Phone:
E-Mail:

Fax:

TWO-WAY STOP CONTROL(TWSC) ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/9/2013
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: KWVP WB OR UT & No Bridge St
 Jurisdiction: Staten Island, NY
 Units: U. S. Customary
 Analysis Year: 2020 With-Action Alt 3
 Project ID: Charleston EIS
 East/West Street: KWVP WB Off-Ramp U-Turn
 North/South Street: North Bridge Street
 Intersection Orientation: NS Study period (hrs): 0.25

Vehicle Volumes and Adjustments

Major Street Movements	1 L	2 T	3 R	4 L	5 T	6 R
Volume					637	
Peak-Hour Factor, PHF					0.93	
Peak-15 Minute Volume					171	
Hourly Flow Rate, HFR					684	
Percent Heavy Vehicles		--	--		--	--
Median Type/Storage	Undivided			/		
RT Channelized?						
Lanes					1	
Configuration					T	
Upstream Signal?		No			No	

Minor Street Movements	7 L	8 T	9 R	10 L	11 T	12 R
Volume	178					
Peak Hour Factor, PHF	0.90					
Peak-15 Minute Volume	49					
Hourly Flow Rate, HFR	197					
Percent Heavy Vehicles	1					
Percent Grade (%)		0			0	
Flared Approach: Exists?/Storage				/		/
RT Channelized?						
Lanes	1					
Configuration	L					

Pedestrian Volumes and Adjustments

Movements	13	14	15	16
Flow (ped/hr)	0	0	0	0

Lane Width (ft)	12.0	12.0	12.0	12.0
Walking Speed (ft/sec)	4.0	4.0	4.0	4.0
Percent Blockage	0	0	0	0

Upstream Signal Data							
	Prog. Flow vph	Sat Flow vph	Arrival Type	Green Time sec	Cycle Length sec	Prog. Speed mph	Distance to Signal feet
S2 Left-Turn Through							
S5 Left-Turn Through							

Worksheet 3-Data for Computing Effect of Delay to Major Street Vehicles

	Movement 2	Movement 5
Shared ln volume, major th vehicles:		
Shared ln volume, major rt vehicles:		
Sat flow rate, major th vehicles:		
Sat flow rate, major rt vehicles:		
Number of major street through lanes:		

Worksheet 4-Critical Gap and Follow-up Time Calculation

Critical Gap Calculation								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(c,base)			7.1					
t(c,hv)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
P(hv)			1					
t(c,g)			0.20	0.20	0.10	0.20	0.20	0.10
Percent Grade			0.00	0.00	0.00	0.00	0.00	0.00
t(3,lt)			0.70					
t(c,T): 1-stage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2-stage	0.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
t(c) 1-stage			6.4					
2-stage								

Follow-Up Time Calculations								
Movement	1	4	7	8	9	10	11	12
	L	L	L	T	R	L	T	R
t(f,base)			3.50					
t(f,HV)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
P(HV)			1					
t(f)			3.5					

Worksheet 5-Effect of Upstream Signals

Computation 1-Queue Clearance Time at Upstream Signal				
	Movement 2		Movement 5	
	V(t)	V(l,prot)	V(t)	V(l,prot)
V prog				

Total Saturation Flow Rate, s (vph)
Arrival Type
Effective Green, g (sec)
Cycle Length, C (sec)
Rp (from Exhibit 16-11)
Proportion vehicles arriving on green P
g(q1)
g(q2)
g(q)

Computation 2-Proportion of TWSC Intersection Time blocked			
	Movement 2		Movement 5
	V(t)	V(l,prot)	V(t) V(l,prot)
alpha			
beta			
Travel time, t(a) (sec)			
Smoothing Factor, F			
Proportion of conflicting flow, f			
Max platooned flow, V(c,max)			
Min platooned flow, V(c,min)			
Duration of blocked period, t(p)			
Proportion time blocked, p		0.000	0.000

Computation 3-Platoon Event Periods	Result
p(2)	0.000
p(5)	0.000
p(dom)	
p(subo)	
Constrained or unconstrained?	

Proportion unblocked for minor movements, p(x)	(1) Single-stage Process	(2) Two-Stage Process Stage I	(3) Process Stage II
p(1)			
p(4)			
p(7)			
p(8)			
p(9)			
p(10)			
p(11)			
p(12)			

Computation 4 and 5 Single-Stage Process								
Movement	1 L	4 L	7 L	8 T	9 R	10 L	11 T	12 R
V c,x			684					
s								
Px								
V c,u,x								
C r,x								
C plat,x								

Two-Stage Process	7	8	10	11
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	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2	Stage1	Stage2
V(c,x)								
s		1500						
P(x)								
V(c,u,x)								
C(r,x)								
C(plat,x)								

Worksheet 6-Impedance and Capacity Equations

Step 1: RT from Minor St.	9	12
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 2: LT from Major St.	4	1
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Maj L-Shared Prob Q free St.		
Step 3: TH from Minor St.	8	11
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor	1.00	1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity		
Probability of Queue free St.	1.00	1.00
Step 4: LT from Minor St.	7	10
Conflicting Flows	684	
Potential Capacity	416	
Pedestrian Impedance Factor	1.00	1.00
Maj. L, Min T Impedance factor		1.00
Maj. L, Min T Adj. Imp Factor.		1.00
Cap. Adj. factor due to Impeding mvmnt	1.00	1.00
Movement Capacity	416	

Worksheet 7-Computation of the Effect of Two-stage Gap Acceptance

Step 3: TH from Minor St.	8	11
Part 1 - First Stage		
Conflicting Flows		
Potential Capacity		
Pedestrian Impedance Factor		
Cap. Adj. factor due to Impeding mvmnt		
Movement Capacity		
Probability of Queue free St.		

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor 1.00 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity

Result for 2 stage process:
a
y
C t
Probability of Queue free St. 1.00 1.00

Step 4: LT from Minor St. 7 10

Part 1 - First Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 2 - Second Stage
Conflicting Flows
Potential Capacity
Pedestrian Impedance Factor
Cap. Adj. factor due to Impeding mvmnt
Movement Capacity

Part 3 - Single Stage
Conflicting Flows 684
Potential Capacity 416
Pedestrian Impedance Factor 1.00 1.00
Maj. L, Min T Impedance factor 1.00
Maj. L, Min T Adj. Imp Factor. 1.00
Cap. Adj. factor due to Impeding mvmnt 1.00 1.00
Movement Capacity 416

Results for Two-stage process:
a
y
C t 416

Worksheet 8-Shared Lane Calculations

Movement	7 L	8 T	9 R	10 L	11 T	12 R
Volume (vph)	197					
Movement Capacity (vph)	416					
Shared Lane Capacity (vph)						

Worksheet 9-Computation of Effect of Flared Minor Street Approaches

Movement	7 L	8 T	9 R	10 L	11 T	12 R
C sep	416					
Volume	197					
Delay						
Q sep						
Q sep +1						
round (Qsep +1)						
n max						
C sh						
SUM C sep						
n						
C act						

Worksheet 10-Delay, Queue Length, and Level of Service

Movement	1	4	7	8	9	10	11	12
Lane Config			L					
v (vph)			197					
C(m) (vph)			416					
v/c			0.47					
95% queue length			2.47					
Control Delay			21.2					
LOS			C					
Approach Delay				21.2				
Approach LOS				C				

Worksheet 11-Shared Major LT Impedance and Delay

	Movement 2	Movement 5
p(oj)	1.00	1.00
v(i1), Volume for stream 2 or 5		
v(i2), Volume for stream 3 or 6		
s(i1), Saturation flow rate for stream 2 or 5		
s(i2), Saturation flow rate for stream 3 or 6		
P*(oj)		
d(M,LT), Delay for stream 1 or 4		
N, Number of major street through lanes		
d(rank,1) Delay for stream 2 or 5		

Alternative 3

Mitigation

Weekday

AM

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/16/13 Jurisd: Staten Island, NY
 Period: Weekday 8-9 AM Peak Period Year : 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	3	6	1	277	34	220	0	216	297	108	166	9
Lane Width	15.5			11.0			15.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	25.0				25.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	708	1700	0.02	0.42	10.3	B	10.3	B
Westbound								
LT	530	1273	0.67	0.42	20.5	C	18.6	B
R	514	1233	0.49	0.42	16.0	B		
Northbound								
LTR	712	1708	0.85	0.42	26.5	C	26.5	C
Southbound								
L	160	385	0.77	0.42	45.0	D		
TR	676	1623	0.30	0.42	12.8	B	25.1	C

Intersection Delay = 23.0 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/16/13
 Analysis Time Period: Weekday 8-9 AM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	6	1	277	34	220	0	216	297	108	166	9
% Heavy Veh	1	1	1	7	7	7	11	11	11	11	11	11
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
PK 15 Vol	1	2	1	80	10	63	0	64	87	31	48	3
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900		1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig		LTR			LT	R		LTR		L	TR	
Lane Width		15.5			11.0	10.0		15.0		10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		11			357	253		603		124	201	
%InSharedLn												
Prop LTs		0.273			0.891			0.000		1.000	0.000	
Prop RTs		0.091			0.000	1.000		0.579			0.050	
Peds Bikes		0			0	0		0			0	
Buses		0			0	0		4		0	3	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3			3	3		3		3	3	
Unit Ext.		3.0			3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			0.940			0.887			1.000	
Lost Time		2.0			2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0		2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		25.0							25.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	3	6	1	277	34	220	0	216	297	108	166	9
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.85	0.85	0.85	0.87	0.87	0.87
Adj flow	3	7	1	318	39	253	0	254	349	124	191	10
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
Lane group	LTR			LT R			LTR			L TR		
Adj flow	11			357 253			603			124 201		
Prop LTs	0.273			0.891			0.000			1.000 0.000		
Prop RTs	0.091			0.000 1.000			0.579			0.050		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			L TR		
So	1900			1900 1900			1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	0		1	1	0
fW	1.117			0.967 0.933			1.100			0.933 0.967		
fHV	0.990			0.935 0.935			0.901			0.901 0.901		
fG	1.000			1.000 1.000			1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.984			1.000 0.988		
fA	1.000			1.000 1.000			1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000			1.000 1.000		
fRT	0.988			1.000 0.850			0.922			0.993		
fLT	0.937			0.741			1.000			0.241 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1700			1273 1233			1708			385 1623		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	11	1700	0.01	0.42	708	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	357	1273	# 0.28	0.42	530	0.67
Right	R	253	1233	0.21	0.42	514	0.49
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	603	1708	# 0.35	0.42	712	0.85
Right							
Southbound							
Prot							
Perm							
Left	L	124	385	0.32	0.42	160	0.77
Prot							
Perm							
Thru	TR	201	1623	0.12	0.42	676	0.30
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.63
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.76

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.42	10.3	1.000	708	0.50	0.0	0.0	10.3	B	10.3	B
Westbound												
LT	0.67	0.42	14.2	1.000	530	0.50	6.3	0.0	20.5	C	18.6	B
R	0.49	0.42	12.8	1.000	514	0.50	3.1	0.0	16.0	B		
Northbound												
LTR	0.85	0.42	15.8	1.000	712	0.50	10.7	0.0	26.5	C	26.5	C
Southbound												
L	0.77	0.42	15.1	1.000	160	0.50	29.9	0.0	45.0	D		
TR	0.30	0.42	11.7	1.000	676	0.50	1.1	0.0	12.8	B	25.1	C

Intersection delay = 23.0 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				25.0
Effective permitted green time for LT lane group, g(s)				25.0
Opposing effective green time, go (s)				25.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				124
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				603
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				2.07
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				10.05
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.58
gq, (see Exhibit C16-4,5,6,7,8)				11.19
gu=g-gq if gq>=gf, or = g-gf if gq<gf				13.81
n=Max(gq-gf)/2,0)				5.60
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.29
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.16
gdifff=max(gq-gf,0)				0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.24
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.241

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when g>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	25.0	25.0	25.0	
Effective permitted green time for LT lane group, g(s)	25.0	25.0	25.0	
Opposing effective green time, go (s)	25.0	25.0	25.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	3	318	0	
Proportion of LT in LT lane group, PLT	0.273	0.891	0.000	0.000
Proportion of LT in opposing flow, PLTo	0.89	0.27	0.00	
Adjusted opposing flow rate, Vo (veh/h)	357	11	201	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.05	5.30	0.00	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.95	0.18	3.35	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.6	0.0	0.0	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.58	0.58	0.58	
gq, (see Exhibit C16-4,5,6,7,8)	5.86	0.00	2.01	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	7.45	25.00	22.99	
n=Max(gq-gf)/2,0)	0.00	0.00	1.00	
PTHo=1-PLTo	0.11	0.73	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.27	0.89	0.00	
EL1 (refer to Exhibit C16-3)	1.99	1.39	1.70	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.10	0.15	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.94	0.74	0.92	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.937	0.741	1.000	

For special case of single-lane approach opposed by multilane approach,
see text.

- * If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.
 - ** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
- For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	25.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	5.86			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.234			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	357			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	1			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	0.273			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		25.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		25.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	1
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	1.000
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	10.3	0.00	0.0	0.0	10.3
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	17.5	14.2	0.00	0.0	0.0	20.5
R	0.0	0.00	17.5	12.8	0.00	0.0	0.0	16.0
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.5	15.8	0.00	0.0	0.0	26.5
	0.0						0.0	
Southbound								
L	0.0	0.00	17.5	15.1	0.00	0.0	0.0	45.0
TR	0.0	0.00	17.5	11.7	0.00	0.0	0.0	12.8
	0.0						0.0	
Intersection Delay			23.0	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		L	TR	
Init Queue	0.0			0.0	0.0	0.0		0.0	0.0	
Flow Rate	11			357	253	603		124	201	
So	1900			1900	1900	1900		1900	1900	
No.Lanes	0	1	0	0	1	1	0	1	1	0
SL	1700			1273	1233	1708		385	1623	
LnCapacity	708			530	514	712		160	676	
Flow Ratio	0.0			0.3	0.2	0.4		0.3	0.1	
v/c Ratio	0.02			0.67	0.49	0.85		0.77	0.30	
Grn Ratio	0.42			0.42	0.42	0.42		0.42	0.42	
I Factor	1.000			0.940		0.887			1.000	
AT or PVG	3			3	3	3		3	3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	1.00	
PF2	1.00			1.00	1.00	1.00		1.00	1.00	
Q1	0.1			4.8	3.1	9.1		1.8	2.2	
kB	0.7			0.5	0.5	0.6		0.2	0.7	
Q2	0.0			1.0	0.5	2.8		0.7	0.3	
Q Average	0.1			5.8	3.6	11.8		2.5	2.5	
Q Spacing	25.0			25.0	25.0	25.0		25.0	25.0	
Q Storage	0			0	0	0		0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.3	1.3	
BOQ	0.2			7.2	4.5	14.3		3.1	3.2	
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.5	1.4		1.6	1.6	
BOQ	0.2			8.7	5.5	16.9		3.9	4.0	
QSRatio										
90th Percentile Output:										
fB%	2.0			1.7	1.7	1.5		1.8	1.8	
BOQ	0.2			9.7	6.2	18.3		4.5	4.5	
QSRatio										
95th Percentile Output:										
fB%	2.6			1.9	2.1	1.7		2.2	2.2	
BOQ	0.3			11.2	7.5	20.0		5.5	5.5	
QSRatio										
98th Percentile Output:										
fB%	3.2			2.2	2.4	1.8		2.6	2.6	
BOQ	0.4			12.7	8.7	21.8		6.5	6.5	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 8 - 9 AM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Staten Island, NY
 Year : 2020 FULL Mitigation Alt. 3
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	49	183	169	203	441	79	107	251	74	68	31	27
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	30.0				25.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	192	577	0.29	0.33	25.1	C		
T	621	1863	0.33	0.33	23.6	C	23.8	C
R	493	1478	0.30	0.33	23.5	C		
Westbound								
L	311	933	0.75	0.33	41.6	D		
TR	1092	3277	0.54	0.33	26.3	C	30.6	C
Northbound								
LT	932	3355	0.41	0.28	27.9	C	27.6	C
R	388	1396	0.21	0.28	26.1	C		
Southbound								
L	376	1694	0.27	0.22	30.7	C		
TR	356	1602	0.24	0.22	30.4	C	30.5	C

Intersection Delay = 28.4 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 8 - 9 AM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	49	183	169	203	441	79	107	251	74	68	31	27
% Heavy Veh	2	2	2	8	8	8	8	8	8	3	3	3
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
PK 15 Vol	14	52	48	58	127	23	29	67	20	25	12	10
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			38			4			0			0
Adj Flow	56	208	149	233	593			385	80	101	86	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.299			0.000	
Prop RTS		0.000	1.000		0.145			0.000	1.000		0.465	
Peds Bikes	0			0		0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.780			0.979			1.000			0.991	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		30.0						25.0	20.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	49	183	169	203	441	79	107	251	74	68	31	27
PHF	0.88	0.88	0.88	0.87	0.87	0.87	0.93	0.93	0.93	0.67	0.67	0.67
Adj flow	56	208	149	233	507	86	115	270	80	101	46	40
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	56	208	149	233	593			385	80	101	86	
Prop LTs	1.000	0.000		1.000	0.000			0.299			0.000	
Prop RTs		0.000	1.000		0.145			0.000	1.000		0.465	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.980	0.980	0.980	0.926	0.926		0.926	0.926		0.971	0.971	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.978		1.000	0.850			0.930	
fLT	0.321	1.000		0.568	1.000		0.985			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	577	1863	1478	933	3277		3355	1396		1694	1602	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	56	577	0.10	0.33	192	0.29
Prot							
Perm							
Thru	T	208	1863	0.11	0.33	621	0.33
Right	R	149	1478	0.10	0.33	493	0.30
Westbound							
Prot							
Perm							
Left	L	233	933	# 0.25	0.33	311	0.75
Prot							
Perm							
Thru	TR	593	3277	0.18	0.33	1092	0.54
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	385	3355	# 0.11	0.28	932	0.41
Right	R	80	1396	0.06	0.28	388	0.21
Southbound							
Prot							
Perm							
Left	L	101	1694	# 0.06	0.22	376	0.27
Prot							
Perm							
Thru	TR	86	1602	0.05	0.22	356	0.24
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.42
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.51

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.29	0.33	22.2	1.000	192	0.50	3.0	0.0	25.1	C			
T	0.33	0.33	22.5	1.000	621	0.50	1.1	0.0	23.6	C	23.8	C	
R	0.30	0.33	22.2	1.000	493	0.50	1.2	0.0	23.5	C			
Westbound													
L	0.75	0.33	26.7	1.000	311	0.50	14.9	0.0	41.6	D			
TR	0.54	0.33	24.4	1.000	1092	0.50	1.9	0.0	26.3	C	30.6	C	
Northbound													
LT	0.41	0.28	26.5	1.000	932	0.50	1.4	0.0	27.9	C	27.6	C	
R	0.21	0.28	24.9	1.000	388	0.50	1.2	0.0	26.1	C			
Southbound													
L	0.27	0.22	29.0	1.000	376	0.50	1.7	0.0	30.7	C			
TR	0.24	0.22	28.8	1.000	356	0.50	1.6	0.0	30.4	C	30.5	C	

Intersection delay = 28.4 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	30.0	30.0		
Effective permitted green time for LT lane group, g(s)	30.0	30.0		
Opposing effective green time, go (s)	30.0	30.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	56	233		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	593	208		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	1.40	5.83		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.79	5.20		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.67	0.67		
gq, (see Exhibit C16-4,5,6,7,8)	7.55	2.84		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	22.45	27.16		
n=Max(gq-gf)/2,0)	3.78	1.42		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.33	1.59		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.13		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.32	0.57		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.321	0.568		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.299 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho^{**n}) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf/g] + [gu/g] / [1 + PL(EL1 - 1)] + [gdifff/g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	30.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	7.55			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.252			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	593			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			

Permitted Right Turns

Effective pedestrian green time, gp (s)	30.0
Conflicting pedestrian volume, Vped (p/h)	0
Conflicting bicycle volume, Vbic (bicycles/h)	0
Vpedg	0
OCCpedg	0.000
Effective green, g (s)	30.0
Vbicg	0

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.145
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial	Dur.	Uniform Delay		Initial	Final	Initial	Lane
	Unmet Demand Q veh	Unmet Demand t hrs.	Unadj. ds	Adj. d1 sec	Queue Param. u	Unmet Demand Q veh	Queue Delay d3 sec	Group Delay d sec
Eastbound								
L	0.0	0.00	30.0	22.2	0.00	0.0	0.0	25.1
T	0.0	0.00	30.0	22.5	0.00	0.0	0.0	23.6
R	0.0	0.00	30.0	22.2	0.00	0.0	0.0	23.5
Westbound								
L	0.0	0.00	30.0	26.7	0.00	0.0	0.0	41.6
TR	0.0	0.00	30.0	24.4	0.00	0.0	0.0	26.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	32.5	26.5	0.00	0.0	0.0	27.9
R	0.0	0.00	32.5	24.9	0.00	0.0	0.0	26.1
Southbound								
L	0.0	0.00	35.0	29.0	0.00	0.0	0.0	30.7
TR	0.0	0.00	35.0	28.8	0.00	0.0	0.0	30.4
	0.0						0.0	

Intersection Delay	28.4	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	L	T	R	L	TR	LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	56	208	149	233	311	202	80	101	86
So	1900	1900	1900	1900	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	2 0	2	1	1	0
SL	577	1863	1478	933	1721	1762	1396	1694	1602
LnCapacity	192	621	493	311	573	489	388	376	356
Flow Ratio	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
v/c Ratio	0.29	0.33	0.30	0.75	0.54	0.41	0.21	0.27	0.24
Grn Ratio	0.33	0.33	0.33	0.33	0.33	0.28	0.28	0.22	0.22
I Factor		0.780			0.979	1.000			0.991
AT or PVG	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	1.0	3.9	2.8	5.2	6.3	4.1	1.5	2.1	1.8
kB	0.3	0.6	0.5	0.5	0.8	0.7	0.6	0.6	0.5
Q2	0.1	0.3	0.2	1.3	0.9	0.5	0.2	0.2	0.2
Q Average	1.1	4.2	3.0	6.5	7.2	4.6	1.7	2.3	1.9
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2	1.3	1.2	1.2	1.2	1.3	1.3	1.3
BOQ	1.5	5.2	3.8	7.9	8.8	5.7	2.1	2.9	2.5
QSRatio									
85th Percentile Output:									
fB%	1.6	1.5	1.6	1.5	1.5	1.5	1.6	1.6	1.6
BOQ	1.9	6.5	4.7	9.6	10.6	7.0	2.7	3.7	3.1
QSRatio									
90th Percentile Output:									
fB%	1.9	1.7	1.8	1.6	1.6	1.7	1.9	1.8	1.8
BOQ	2.2	7.2	5.3	10.6	11.7	7.8	3.1	4.2	3.6
QSRatio									
95th Percentile Output:									
fB%	2.4	2.0	2.1	1.9	1.8	2.0	2.3	2.2	2.3
BOQ	2.8	8.6	6.4	12.1	13.2	9.2	3.9	5.1	4.4
QSRatio									
98th Percentile Output:									
fB%	2.9	2.3	2.5	2.1	2.1	2.3	2.8	2.6	2.7
BOQ	3.3	9.9	7.6	13.7	14.8	10.6	4.7	6.1	5.3
QSRatio									

ERROR MESSAGES

No errors to report.

Weekday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/16/13 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	1	17	6	276	24	370	1	199	259	211	214	1
Lane Width	15.5			11.0			15.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	24.0				26.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
LTR	684	1710	0.04	0.40	11.1	B	11.1	B
Westbound								
LT	501	1253	0.67	0.40	20.9	C	25.4	C
R	498	1244	0.83	0.40	29.1	C		
Northbound								
LTR	744	1718	0.67	0.43	18.0	B	18.0	B
Southbound								
L	286	661	0.86	0.43	41.9	D		
TR	731	1688	0.34	0.43	12.6	B	27.1	C

Intersection Delay = 23.6 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/16/13
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	17	6	276	24	370	1	199	259	211	214	1
% Heavy Veh	4	4	4	6	6	6	11	11	11	7	7	7
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
PK 15 Vol	1	5	2	77	7	103	1	54	70	61	62	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900		1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig		LTR			LT	R		LTR		L	TR	
Lane Width		15.5			11.0	10.0		15.0		10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		28			334	411		499		245	250	
%InSharedLn												
Prop LTs		0.036			0.919			0.002		1.000	0.000	
Prop RTs		0.250			0.000	1.000		0.565		0.004		
Peds Bikes	0			0	0		0			0		0
Buses		0			0	0		3		0	4	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3			3	3		3		3	3	
Unit Ext.		3.0			3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			0.887			0.931			1.000	
Lost Time		2.0			2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0		2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		24.0							26.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	17	6	276	24	370	1	199	259	211	214	1
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.92	0.92	0.92	0.86	0.86	0.86
Adj flow	1	20	7	307	27	411	1	216	282	245	249	1
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
Lane group	LTR			LT R			LTR			L TR		
Adj flow	28			334 411			499			245 250		
Prop LTs	0.036			0.919			0.002			1.000 0.000		
Prop RTs	0.250			0.000 1.000			0.565			0.004		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			L TR		
So	1900			1900 1900			1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	0		1	1	0
fW	1.117			0.967 0.933			1.100			0.933 0.967		
fHV	0.962			0.943 0.943			0.901			0.935 0.935		
fG	1.000			1.000 1.000			1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988			1.000 0.984		
fA	1.000			1.000 1.000			1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000			1.000 1.000		
fRT	0.966			1.000 0.850			0.924			0.999		
fLT	0.992			0.723			1.000			0.399 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1710			1253 1244			1718			661 1688		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	28	1710	0.02	0.40	684	0.04
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	334	1253	0.27	0.40	501	0.67
Right	R	411	1244	# 0.33	0.40	498	0.83
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	499	1718	0.29	0.43	744	0.67
Right							
Southbound							
Prot							
Perm							
Left	L	245	661	# 0.37	0.43	286	0.86
Prot							
Perm							
Thru	TR	250	1688	0.15	0.43	731	0.34
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.84

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
LTR	0.04	0.40	11.0	1.000	684	0.50	0.1	0.0	11.1	B	11.1	B	
Westbound													
LT	0.67	0.40	14.7	1.000	501	0.50	6.1	0.0	20.9	C	25.4	C	
R	0.83	0.40	16.1	1.000	498	0.50	13.0	0.0	29.1	C			
Northbound													
LTR	0.67	0.43	13.6	1.000	744	0.50	4.5	0.0	18.0	B	18.0	B	
Southbound													
L	0.86	0.43	15.3	1.000	286	0.50	26.6	0.0	41.9	D			
TR	0.34	0.43	11.3	1.000	731	0.50	1.3	0.0	12.6	B	27.1	C	

Intersection delay = 23.6 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				26.0
Effective permitted green time for LT lane group, g(s)				26.0
Opposing effective green time, go (s)				26.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				245
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.00
Adjusted opposing flow rate, Vo (veh/h)				499
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLT/3600				4.08
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				8.32
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.57
gq, (see Exhibit C16-4,5,6,7,8)				8.59
gu=g-gq if gq>=gf, or = g-gf if gq<gf				17.41
n=Max(gq-gf)/2,0)				4.30
PTHo=1-PLTo				1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.08
EL2=Max((1-Ptho**n)/Plto, 1.0)				4.28
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.15
gdifff=max(gq-gf,0)				8.59
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.40
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.399

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	24.0	24.0	26.0	
Effective permitted green time for LT lane group, g(s)	24.0	24.0	26.0	
Opposing effective green time, go (s)	24.0	24.0	26.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	307	1	
Proportion of LT in LT lane group, PLT	0.036	0.919	0.002	0.000
Proportion of LT in opposing flow, PLTo	0.92	0.04	0.00	
Adjusted opposing flow rate, Vo (veh/h)	334	28	250	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	5.12	0.02	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	5.57	0.47	4.17	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	17.9	0.0	19.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.60	0.60	0.57	
gq, (see Exhibit C16-4,5,6,7,8)	5.64	0.00	3.03	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.10	24.00	6.19	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.08	0.96	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.04	0.92	0.00	
EL1 (refer to Exhibit C16-3)	1.95	1.42	1.79	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.16	0.08	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.99	0.72	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.992	0.723	1.000	

For special case of single-lane approach opposed by multilane approach,
see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto
left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach
or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	24.0		26.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	5.64		3.03	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.235		0.116	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	334		250	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.036		0.002	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)	24.0		26.0
Conflicting pedestrian volume, Vped (p/h)	0		0
Conflicting bicycle volume, Vbic (bicycles/h)	0		0
Vpedg	0		0
OCCpedg	0.000		0.000
Effective green, g (s)	24.0		26.0
Vbicg	0		0

OCChicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.004
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
	0.0						0.0	
LTR	0.0	0.00	18.0	11.0	0.00	0.0	0.0	11.1
	0.0						0.0	
Westbound								
	0.0						0.0	
LT	0.0	0.00	18.0	14.7	0.00	0.0	0.0	20.9
R	0.0	0.00	18.0	16.1	0.00	0.0	0.0	29.1
Northbound								
	0.0						0.0	
LTR	0.0	0.00	17.0	13.6	0.00	0.0	0.0	18.0
	0.0						0.0	
Southbound								
L	0.0	0.00	17.0	15.3	0.00	0.0	0.0	41.9
TR	0.0	0.00	17.0	11.3	0.00	0.0	0.0	12.6
	0.0						0.0	
Intersection Delay			23.6	sec/veh	Intersection LOS C			

BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		L	TR	
Init Queue	0.0			0.0	0.0	0.0		0.0	0.0	
Flow Rate	28			334	411	499		245	250	
So	1900			1900	1900	1900		1900	1900	
No.Lanes	0	1	0	0	1	1	0	1	1	0
SL	1710			1253	1244	1718		661	1688	
LnCapacity	684			501	498	744		286	731	
Flow Ratio	0.0			0.3	0.3	0.3		0.4	0.1	
v/c Ratio	0.04			0.67	0.83	0.67		0.86	0.34	
Grn Ratio	0.40			0.40	0.40	0.43		0.43	0.43	
I Factor	1.000			0.887		0.931			1.000	
AT or PVG	3			3	3	3		3	3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	1.00	
PF2	1.00			1.00	1.00	1.00		1.00	1.00	
Q1	0.3			4.6	6.1	6.6		3.7	2.8	
kB	0.7			0.5	0.5	0.7		0.4	0.7	
Q2	0.0			0.9	1.9	1.3		1.6	0.4	
Q Average	0.3			5.5	8.0	7.9		5.3	3.1	
Q Spacing	25.0			25.0	25.0	25.0		25.0	25.0	
Q Storage	0			0	0	0		0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2	1.3	
BOQ	0.4			6.7	9.8	9.7		6.6	3.9	
QSRatio										
85th Percentile Output:										
fB%	1.7			1.5	1.5	1.5		1.5	1.6	
BOQ	0.5			8.2	11.7	11.6		8.0	4.9	
QSRatio										
90th Percentile Output:										
fB%	2.0			1.7	1.6	1.6		1.7	1.8	
BOQ	0.6			9.1	12.8	12.7		8.9	5.5	
QSRatio										
95th Percentile Output:										
fB%	2.5			1.9	1.8	1.8		1.9	2.1	
BOQ	0.8			10.6	14.4	14.3		10.3	6.7	
QSRatio										
98th Percentile Output:										
fB%	3.1			2.2	2.0	2.0		2.2	2.5	
BOQ	1.0			12.0	16.1	15.9		11.8	7.8	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island, NY
 Period: Weekday 12-1 PM MD Peak Period Year : 2020 FULL Mitigation Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	93	326	152	215	600	84	157	326	223	149	67	40
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	35.0				24.0	16.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	184	473	0.60	0.39	33.9	C		
T	732	1881	0.53	0.39	23.5	C	24.4	C
R	580	1492	0.25	0.39	19.5	B		
Westbound								
L	246	633	0.97	0.39	75.4	E		
TR	1306	3359	0.57	0.39	23.3	C	35.9	D
Northbound								
LT	928	3480	0.56	0.27	30.9	C	32.6	C
R	386	1449	0.62	0.27	36.4	D		
Southbound								
L	304	1711	0.61	0.18	42.9	D		
TR	292	1641	0.46	0.18	38.2	D	40.9	D

Intersection Delay = 32.9 (sec/veh) Intersection LOS = C

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 12-1 PM MD Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 FULL Mitigation Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	93	326	152	215	600	84	157	326	223	149	67	40
% Heavy Veh	1	1	1	6	6	6	4	4	4	2	2	2
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
PK 15 Vol	28	97	45	60	167	23	42	88	60	47	21	12
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1900	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			32			13			0			0
Adj Flow	111	388	143	239	746			520	240	186	134	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.325			0.000	
Prop RTS		0.000	1.000		0.106			0.000	1.000		0.373	
Peds Bikes	0			0		0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.856			0.927			1.000			0.985	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination 1				2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds		
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		35.0						24.0	16.0	
Yellow		3.0						3.0	3.0	
All Red		2.0						2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	93	326	152	215	600	84	157	326	223	149	67	40
PHF	0.84	0.84	0.84	0.90	0.90	0.90	0.93	0.93	0.93	0.80	0.80	0.80
Adj flow	111	388	143	239	667	79	169	351	240	186	84	50
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	111	388	143	239	746			520	240	186	134	
Prop LTs	1.000	0.000		1.000	0.000			0.325			0.000	
Prop RTs		0.000	1.000		0.106			0.000	1.000		0.373	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1900	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.943	0.943		0.962	0.962		0.980	0.980	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.984		1.000	0.850			0.944	
fLT	0.260	1.000		0.379	1.000		0.984			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	473	1881	1492	633	3359		3480	1449		1711	1641	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	111	473	0.23	0.39	184	0.60
Prot							
Perm							
Thru	T	388	1881	0.21	0.39	732	0.53
Right	R	143	1492	0.10	0.39	580	0.25
Westbound							
Prot							
Perm							
Left	L	239	633	# 0.38	0.39	246	0.97
Prot							
Perm							
Thru	TR	746	3359	0.22	0.39	1306	0.57
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	520	3480	0.15	0.27	928	0.56
Right	R	240	1449	# 0.17	0.27	386	0.62
Southbound							
Prot							
Perm							
Left	L	186	1711	# 0.11	0.18	304	0.61
Prot							
Perm							
Thru	TR	134	1641	0.08	0.18	292	0.46
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.65
Total lost time per cycle, L = 15.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.78

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.60	0.39	22.0	1.000	184	0.50	11.9	0.0	33.9	C			
T	0.53	0.39	21.2	1.000	732	0.50	2.3	0.0	23.5	C	24.4	C	
R	0.25	0.39	18.6	1.000	580	0.50	0.9	0.0	19.5	B			
Westbound													
L	0.97	0.39	27.0	1.000	246	0.50	48.4	0.0	75.4	E			
TR	0.57	0.39	21.6	1.000	1306	0.50	1.7	0.0	23.3	C	35.9	D	
Northbound													
LT	0.56	0.27	28.5	1.000	928	0.50	2.4	0.0	30.9	C	32.6	C	
R	0.62	0.27	29.0	1.000	386	0.50	7.3	0.0	36.4	D			
Southbound													
L	0.61	0.18	34.1	1.000	304	0.50	8.8	0.0	42.9	D			
TR	0.46	0.18	33.1	1.000	292	0.50	5.0	0.0	38.2	D	40.9	D	

Intersection delay = 32.9 (sec/veh) Intersection LOS = C

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	35.0	35.0		
Effective permitted green time for LT lane group, g(s)	35.0	35.0		
Opposing effective green time, go (s)	35.0	35.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	111	239		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	746	388		
Lost time for LT lane group, tL	5.00	5.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	2.78	5.98		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.80	9.70		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.61	0.61		
gq, (see Exhibit C16-4,5,6,7,8)	10.30	10.11		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	24.70	24.89		
n=Max(gq-gf)/2,0)	5.15	5.06		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.71	1.88		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.11	0.11		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.26	0.38		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.260	0.379		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.325 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	35.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.30			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.294			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	746			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		35.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		35.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.106
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	27.5	22.0	0.00	0.0	0.0	33.9
T	0.0	0.00	27.5	21.2	0.00	0.0	0.0	23.5
R	0.0	0.00	27.5	18.6	0.00	0.0	0.0	19.5
Westbound								
L	0.0	0.00	27.5	27.0	0.00	0.0	0.0	75.4
TR	0.0	0.00	27.5	21.6	0.00	0.0	0.0	23.3
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	33.0	28.5	0.00	0.0	0.0	30.9
R	0.0	0.00	33.0	29.0	0.00	0.0	0.0	36.4
Southbound								
L	0.0	0.00	37.0	34.1	0.00	0.0	0.0	42.9
TR	0.0	0.00	37.0	33.1	0.00	0.0	0.0	38.2
	0.0						0.0	

Intersection Delay	32.9	sec/veh	Intersection LOS	C
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound			Northbound		Southbound	
LaneGroup	L	T	R	L	TR		LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Flow Rate	111	388	143	239	391		273	240	186	134
So	1900	1900	1900	1900	1900		1900	1900	1900	1900
No.Lanes	1	1	1	1	2	0	2	1	1	0
SL	473	1881	1492	633	1764		1827	1449	1711	1641
LnCapacity	184	732	580	246	685		487	386	304	292
Flow Ratio	0.2	0.2	0.1	0.4	0.2		0.1	0.2	0.1	0.1
v/c Ratio	0.60	0.53	0.25	0.97	0.57		0.56	0.62	0.61	0.46
Grn Ratio	0.39	0.39	0.39	0.39	0.39		0.27	0.27	0.18	0.18
I Factor		0.856			0.927		1.000			0.985
AT or PVG	3	3	3	3	3		3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00
Q1	2.2	7.5	2.4	5.9	7.7		5.9	5.3	4.3	3.0
kB	0.3	0.8	0.7	0.4	0.8		0.7	0.6	0.5	0.5
Q2	0.4	0.9	0.2	3.0	1.1		0.9	0.9	0.7	0.4
Q Average	2.6	8.3	2.6	8.9	8.7		6.7	6.2	5.0	3.4
Q Spacing	25.0	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0		0	0	0	0
Q S Ratio										
70th Percentile Output:										
fB%	1.3	1.2	1.3	1.2	1.2		1.2	1.2	1.2	1.3
BOQ	3.3	10.2	3.3	10.8	10.6		8.3	7.6	6.2	4.2
QSRatio										
85th Percentile Output:										
fB%	1.6	1.5	1.6	1.5	1.5		1.5	1.5	1.5	1.6
BOQ	4.2	12.1	4.2	12.9	12.7		10.0	9.2	7.6	5.3
QSRatio										
90th Percentile Output:										
fB%	1.8	1.6	1.8	1.6	1.6		1.6	1.6	1.7	1.8
BOQ	4.8	13.3	4.7	14.1	13.9		11.0	10.2	8.5	6.0
QSRatio										
95th Percentile Output:										
fB%	2.2	1.8	2.2	1.8	1.8		1.9	1.9	2.0	2.1
BOQ	5.8	14.9	5.8	15.7	15.5		12.5	11.7	9.9	7.2
QSRatio										
98th Percentile Output:										
fB%	2.6	2.0	2.6	2.0	2.0		2.1	2.1	2.2	2.5
BOQ	6.8	16.5	6.8	17.4	17.1		14.1	13.2	11.3	8.4
QSRatio										

ERROR MESSAGES

No errors to report.

Weekday

PM

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/16/13 Jurisd: Staten Island, NY
 Period: Weekday 5-6 PM Peak Period Year : 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	1	11	2	354	20	279	4	207	317	267	284	1
Lane Width	15.5			11.0			15.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	23.0				27.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	667	1739	0.02	0.38	11.6	B	11.6	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	486	1269	0.94	0.38	44.6	D	35.6	D
R	481	1256	0.71	0.38	23.6	C		

Northbound

LTR	812	1804	0.70	0.45	17.8	B	17.8	B
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Southbound

L	274	608	1.13	0.45	111.0	F		
TR	766	1702	0.43	0.45	13.0	B	60.4	E

Intersection Delay = 38.3 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/16/13
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	1	11	2	354	20	279	4	207	317	267	284	1
% Heavy Veh	3	3	3	5	5	5	5	5	5	7	7	7
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
PK 15 Vol	1	3	1	108	6	85	1	56	85	78	83	1
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900		1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig		LTR			LT	R		LTR		L	TR	
Lane Width		15.5			11.0	10.0		15.0		10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			456	340		568		310	331	
%InSharedLn												
Prop LTs		0.063			0.947			0.007		1.000	0.000	
Prop RTs		0.125			0.000	1.000		0.600		0.003		
Peds Bikes		0			0	0		0		0		0
Buses		0			0	0		3		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3			3	3		3		3	3	
Unit Ext.		3.0			3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			0.933			0.919			1.000	
Lost Time		2.0			2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0		2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		23.0							27.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	1	11	2	354	20	279	4	207	317	267	284	1
PHF	0.88	0.88	0.88	0.82	0.82	0.82	0.93	0.93	0.93	0.86	0.86	0.86
Adj flow	1	13	2	432	24	340	4	223	341	310	330	1
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
Lane group	LTR			LT R			LTR			L TR		
Adj flow	16			456 340			568			310 331		
Prop LTs	0.063			0.947			0.007			1.000 0.000		
Prop RTs	0.125			0.000 1.000			0.600			0.003		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
LG	LTR			LT R			LTR			L TR		
So	1900			1900 1900			1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	0		1	1	0
fW	1.117			0.967 0.933			1.100			0.933 0.967		
fHV	0.971			0.952 0.952			0.952			0.935 0.935		
fG	1.000			1.000 1.000			1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.988			1.000 0.992		
fA	1.000			1.000 1.000			1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000			1.000 1.000		
fRT	0.983			1.000 0.850			0.919			1.000		
fLT	0.982			0.726			0.998			0.367 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1739			1269 1256			1804			608 1702		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1739	0.01	0.38	667	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	456	1269	# 0.36	0.38	486	0.94
Right	R	340	1256	0.27	0.38	481	0.71
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	568	1804	0.31	0.45	812	0.70
Right							
Southbound							
Prot							
Perm							
Left	L	310	608	# 0.51	0.45	274	1.13
Prot							
Perm							
Thru	TR	331	1702	0.19	0.45	766	0.43
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.87
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.04

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.38	11.5	1.000	667	0.50	0.1	0.0	11.6	B	11.6	B
Westbound												
LT	0.94	0.38	17.8	1.000	486	0.50	26.8	0.0	44.6	D	35.6	D
R	0.71	0.38	15.6	1.000	481	0.50	7.9	0.0	23.6	C		
Northbound												
LTR	0.70	0.45	13.2	1.000	812	0.50	4.6	0.0	17.8	B	17.8	B
Southbound												
L	1.13	0.45	16.5	1.000	274	0.50	94.5	0.0	111.0	F		
TR	0.43	0.45	11.3	1.000	766	0.50	1.8	0.0	13.0	B	60.4	E

Intersection delay = 38.3 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				27.0
Effective permitted green time for LT lane group, g(s)				27.0
Opposing effective green time, go (s)				27.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				310
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				568
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				5.17
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				9.47
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.55
gq, (see Exhibit C16-4,5,6,7,8)				9.53
gu=g-gq if gq>=gf, or = g-gf if gq<gf				17.47
n=Max(gq-gf)/2,0)				4.77
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.22
EL2=Max((1-Ptho**n)/Plto, 1.0)				4.70
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.15
gdifff=max(gq-gf,0)				9.53
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.37
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.367

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	23.0	23.0	27.0	
Effective permitted green time for LT lane group, g(s)	23.0	23.0	27.0	
Opposing effective green time, go (s)	23.0	23.0	27.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	1	432	4	
Proportion of LT in LT lane group, PLT	0.063	0.947	0.007	0.000
Proportion of LT in opposing flow, PLTo	0.95	0.06	0.00	
Adjusted opposing flow rate, Vo (veh/h)	456	16	331	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.02	7.20	0.07	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.60	0.27	5.52	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	16.9	0.0	18.8	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.62	0.62	0.55	
gq, (see Exhibit C16-4,5,6,7,8)	8.88	0.00	4.63	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	6.05	23.00	8.21	
n=Max(gq-gf)/2,0)	0.00	0.00	0.00	
PTHo=1-PLTo	0.05	0.94	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.06	0.95	0.01	
EL1 (refer to Exhibit C16-3)	2.20	1.40	1.94	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.00	1.00		
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.17	0.07	
gdifff=max(gq-gf,0)	0.00	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.98	0.73	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.982	0.726	0.998	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

_____SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET_____

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	23.0		27.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	8.88		4.63	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.386		0.172	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	456		331	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.063		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		23.0		27.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		23.0		27.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.003
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

Cycle length, C	60.0	sec	EBLT	WBLT	NBLT	SBLT
Adj. LT vol from Vol Adjustment Worksheet, v						
v/c ratio from Capacity Worksheet, X						
Protected phase effective green interval, g (s)						
Opposing queue effective green interval, gq						
Unopposed green interval, gu						
Red time $r=(C-g-gq-gu)$						
Arrival rate, $qa=v/(3600(\max[X,1.0]))$						
Protected ph. departure rate, $Sp=s/3600$						
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$						
XPerm						
XProt						
Case						
Queue at beginning of green arrow, Qa						
Queue at beginning of unsaturated green, Qu						
Residual queue, Qr						
Uniform Delay, d1						

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	18.5	11.5	0.00	0.0	0.0 0.0 0.0	11.6
Westbound								
LT	0.0	0.00	18.5	17.8	0.00	0.0	0.0	44.6
R	0.0	0.00	18.5	15.6	0.00	0.0	0.0	23.6
Northbound								
LTR	0.0 0.0 0.0	0.00	16.5	13.2	0.00	0.0	0.0 0.0 0.0	17.8
Southbound								
L	0.0	0.00	16.5	16.5	0.00	9.0	0.0	111.0
TR	0.0 0.0	0.00	16.5	11.3	0.00	0.0	0.0 0.0	13.0

Intersection Delay	38.3	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound		
LaneGroup	LTR			LT	R	LTR		L	TR	
Init Queue	0.0			0.0	0.0	0.0		0.0	0.0	
Flow Rate	16			456	340	568		310	331	
So	1900			1900	1900	1900		1900	1900	
No.Lanes	0	1	0	0	1	1	0	1	1	0
SL	1739			1269	1256	1804		608	1702	
LnCapacity	667			486	481	812		274	766	
Flow Ratio	0.0			0.4	0.3	0.3		0.5	0.2	
v/c Ratio	0.02			0.94	0.71	0.70		1.13	0.43	
Grn Ratio	0.38			0.38	0.38	0.45		0.45	0.45	
I Factor	1.000			0.933		0.919			1.000	
AT or PVG	3			3	3	3		3	3	
Pltn Ratio	1.00			1.00	1.00	1.00		1.00	1.00	
PF2	1.00			1.00	1.00	1.00		1.00	1.00	
Q1	0.2			7.3	4.8	7.6		5.2	3.8	
kB	0.6			0.5	0.5	0.7		0.3	0.7	
Q2	0.0			3.7	1.1	1.5		6.6	0.5	
Q Average	0.2			11.0	5.9	9.1		11.7	4.3	
Q Spacing	25.0			25.0	25.0	25.0		25.0	25.0	
Q Storage	0			0	0	0		0	0	
Q S Ratio										
70th Percentile Output:										
fB%	1.3			1.2	1.2	1.2		1.2	1.2	
BOQ	0.2			13.4	7.2	11.1		14.2	5.3	
QSRatio										
85th Percentile Output:										
fB%	1.7			1.4	1.5	1.4		1.4	1.5	
BOQ	0.3			15.8	8.8	13.2		16.7	6.6	
QSRatio										
90th Percentile Output:										
fB%	2.0			1.6	1.7	1.6		1.5	1.7	
BOQ	0.4			17.1	9.7	14.4		18.1	7.4	
QSRatio										
95th Percentile Output:										
fB%	2.6			1.7	1.9	1.8		1.7	2.0	
BOQ	0.5			18.9	11.2	16.1		19.9	8.7	
QSRatio										
98th Percentile Output:										
fB%	3.1			1.9	2.2	1.9		1.8	2.3	
BOQ	0.6			20.6	12.7	17.7		21.6	10.0	
QSRatio										

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML
 Agency: AECOM
 Date: 08/29/2013
 Period: Weekday 5-6 PM Peak Period
 Project ID: Charleston EIS
 E/W St: Veterans Road West

Inter.: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisd: Sat Flow Rate WB-L = 1950
 Year : 2020 FULL Mitigated Alt. 3
 N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Volume	108	344	210	247	532	87	159	285	150	223	77	56
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left		P	
Thru	P				Thru		P	
Right	P				Right		P	
Peds	X				Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	32.0				23.0	20.0		
Yellow	3.0				3.0	3.0		
All Red	2.0				2.0	2.0		

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	159	447	0.77	0.36	48.0	D		
T	669	1881	0.58	0.36	26.2	C	29.1	C
R	530	1492	0.35	0.36	22.7	C		
Westbound								
L	255	696	1.07	0.37	104.6	F		
TR	1216	3317	0.61	0.37	25.4	C	46.8	D
Northbound								
LT	896	3508	0.53	0.26	31.1	C	30.9	C
R	374	1463	0.36	0.26	30.1	C		
Southbound								
L	384	1728	0.76	0.22	45.8	D		
TR	373	1680	0.38	0.22	32.6	C	41.5	D

Intersection Delay = 37.9 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Weekday 5-6 PM Peak Period
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Sat Flow Rate WB-L = 1950
 Analysis Year: 2020 FULL Mitigated Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	108	344	210	247	532	87	159	285	150	223	77	56
% Heavy Veh	1	1	1	7	7	7	3	3	3	1	1	1
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
PK 15 Vol	31	98	60	69	162	27	43	77	40	73	25	18
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	1950	1900			1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR			LT	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0			12.5	10.0	11.0	10.0	
RTOR Vol			45			11			25			25
Adj Flow	123	391	188	274	742			477	134	293	142	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000			0.358			0.000	
Prop RTS		0.000	1.000		0.125			0.000	1.000		0.289	
Peds Bikes	0			0	0	0		0		0		
Buses	0	0	0	0	0			0	0	0	0	
%InProtPhase												
Duration	0.25											

Area Type: All other areas

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3		3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	
I Factor		0.701			0.949			1.000			0.970	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0		2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0		2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination				1	2	3	4	5	6	7	8
EB	Left	P						NB	Left	P	
	Thru	P							Thru	P	
	Right	P							Right	P	
	Peds								Peds		
WB	Left	P						SB	Left	P	
	Thru	P							Thru	P	
	Right	P							Right	P	
	Peds	X							Peds		
NB	Right							EB	Right		
SB	Right							WB	Right		
Green		32.0							23.0	20.0	
Yellow		3.0							3.0	3.0	
All Red		2.0							2.0	2.0	

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	108	344	210	247	532	87	159	285	150	223	77	56
PHF	0.88	0.88	0.88	0.90	0.82	0.82	0.93	0.93	0.93	0.76	0.76	0.76
Adj flow	123	391	188	274	649	93	171	306	134	293	101	41
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR			LT	R	L	TR	
Adj flow	123	391	188	274	742			477	134	293	142	
Prop LTs	1.000	0.000		1.000	0.000			0.358			0.000	
Prop RTs		0.000	1.000		0.125			0.000	1.000		0.289	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		LT	R		L	TR	
So	1900	1900	1900	1950	1900		1900	1900		1900	1900	
Lanes	1	1	1	1	2	0	2	1		1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.017	0.933		0.967	0.933	
fHV	0.990	0.990	0.990	0.935	0.935		0.971	0.971		0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000		1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		0.952	1.000		1.000	1.000	
fRT		1.000	0.850		0.981		1.000	0.850			0.957	
fLT	0.246	1.000		0.409*	1.000		0.982			0.950	1.000	
Sec.												
fLpb	1.000	1.000		1.000	1.000		1.000			1.000	1.000	
fRpb		1.000	1.000		1.000		1.000	1.000			1.000	
S	447	1881	1492	696	3317		3508	1463		1728	1680	
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left	L	123	447	0.28	0.36	159	0.77
Prot							
Perm							
Thru	T	391	1881	0.21	0.36	669	0.58
Right	R	188	1492	0.13	0.36	530	0.35
Westbound							
Prot							
Perm							
Left	L	274	696	# 0.39	0.37	255	1.07
Prot							
Perm							
Thru	TR	742	3317	0.22	0.37	1216	0.61
Right							
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	477	3508	# 0.14	0.26	896	0.53
Right	R	134	1463	0.09	0.26	374	0.36
Southbound							
Prot							
Perm							
Left	L	293	1728	# 0.17	0.22	384	0.76
Prot							
Perm							
Thru	TR	142	1680	0.08	0.22	373	0.38
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.70
Total lost time per cycle, L = 14.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 0.83

Control Delay and LOS Determination

Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
L	0.77	0.36	25.8	1.000	159	0.50	22.3	0.0	48.0	D		
T	0.58	0.36	23.6	1.000	669	0.50	2.6	0.0	26.2	C	29.1	C
R	0.35	0.36	21.4	1.000	530	0.50	1.3	0.0	22.7	C		
Westbound												
L	1.07	0.37	28.5	1.000	255	0.50	76.1	0.0	104.6	F		
TR	0.61	0.37	23.3	1.000	1216	0.50	2.2	0.0	25.4	C	46.8	D
Northbound												
LT	0.53	0.26	28.9	1.000	896	0.50	2.3	0.0	31.1	C	30.9	C
R	0.36	0.26	27.5	1.000	374	0.50	2.7	0.0	30.1	C		
Southbound												
L	0.76	0.22	32.8	1.000	384	0.50	13.0	0.0	45.8	D		
TR	0.38	0.22	29.7	1.000	373	0.50	2.8	0.0	32.6	C	41.5	D

Intersection delay = 37.9 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)	32.0	32.0		
Effective permitted green time for LT lane group, g(s)	32.0	33.0		
Opposing effective green time, go (s)	33.0	32.0		
Number of lanes in LT lane group, N	1	1		
Number of lanes in opposing approach, No	2	1		
Adjusted LT flow rate, VLT (veh/h)	123	274		
Proportion of LT in LT lane group, PLT	1.000	1.000		
Proportion of LT in opposing flow, PLTo	0.00	0.00		
Adjusted opposing flow rate, Vo (veh/h)	742	391		
Lost time for LT lane group, tL	5.00	4.00		
Computation				
LT volume per cycle, LTC=VLTC/3600	3.08	6.85		
Opposing lane util. factor, fLUo	0.952	1.000	1.000	0.952
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	9.74	9.77		
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0		
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00		
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.63	0.64		
gq, (see Exhibit C16-4,5,6,7,8)	10.75	12.10		
gu=g-gq if gq>=gf, or = g-gf if gq<gf	21.25	20.90		
n=Max(gq-gf)/2,0)	5.38	6.05		
PTHo=1-PLTo	1.00	1.00		
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00		
EL1 (refer to Exhibit C16-3)	2.70	1.88		
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+PL)/g	0.13	0.12		
gdifff=max(gq-gf,0)	0.00	0.00		
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.25	0.34		
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.246	0.409*		

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C	90.0	sec		
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.358 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 0.952
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / Plto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $Pl \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	32.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	10.75			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.336			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	742			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		32.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		33.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.125
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0	sec		
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00	29.0	25.8	0.00	0.0	0.0	48.0
T	0.0	0.00	29.0	23.6	0.00	0.0	0.0	26.2
R	0.0	0.00	29.0	21.4	0.00	0.0	0.0	22.7
Westbound								
L	0.0	0.00	28.5	28.5	0.00	4.8	0.0	104.6
TR	0.0	0.00	28.5	23.3	0.00	0.0	0.0	25.4
	0.0						0.0	
Northbound								
	0.0						0.0	
LT	0.0	0.00	33.5	28.9	0.00	0.0	0.0	31.1
R	0.0	0.00	33.5	27.5	0.00	0.0	0.0	30.1
Southbound								
L	0.0	0.00	35.0	32.8	0.00	0.0	0.0	45.8
TR	0.0	0.00	35.0	29.7	0.00	0.0	0.0	32.6
	0.0						0.0	

Intersection Delay	37.9	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound		Southbound	
LaneGroup	L	T	R	L	TR	LT	R	L	TR
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flow Rate	123	391	188	274	389	250	134	293	142
So	1900	1900	1900	1950	1900	1900	1900	1900	1900
No.Lanes	1	1	1	1	2	2	1	1	0
SL	447	1881	1492	696	1742	1842	1463	1728	1680
LnCapacity	159	669	530	255	638	470	374	384	373
Flow Ratio	0.3	0.2	0.1	0.4	0.2	0.1	0.1	0.2	0.1
v/c Ratio	0.77	0.58	0.35	1.07	0.61	0.53	0.36	0.76	0.38
Grn Ratio	0.36	0.36	0.36	0.37	0.37	0.26	0.26	0.22	0.22
I Factor		0.701			0.949	1.000			0.970
AT or PVG	3	3	3	3	3	3	3	3	3
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Q1	2.7	8.0	3.5	6.8	7.9	5.4	2.7	6.9	3.0
kB	0.2	0.6	0.5	0.4	0.8	0.7	0.6	0.6	0.6
Q2	0.7	0.8	0.3	5.1	1.2	0.7	0.3	1.6	0.3
Q Average	3.4	8.8	3.7	12.0	9.1	6.1	3.1	8.5	3.4
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Q Storage	0	0	0	0	0	0	0	0	0
Q S Ratio									
70th Percentile Output:									
fB%	1.3	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.3
BOQ	4.2	10.7	4.7	14.5	11.1	7.5	3.8	10.3	4.2
QSRatio									
85th Percentile Output:									
fB%	1.6	1.5	1.5	1.4	1.4	1.5	1.6	1.5	1.6
BOQ	5.3	12.7	5.8	17.1	13.2	9.1	4.8	12.3	5.2
QSRatio									
90th Percentile Output:									
fB%	1.8	1.6	1.7	1.5	1.6	1.6	1.8	1.6	1.8
BOQ	5.9	13.9	6.5	18.5	14.4	10.1	5.4	13.5	5.9
QSRatio									
95th Percentile Output:									
fB%	2.1	1.8	2.1	1.7	1.8	1.9	2.1	1.8	2.1
BOQ	7.1	15.6	7.8	20.3	16.1	11.6	6.6	15.1	7.1
QSRatio									
98th Percentile Output:									
fB%	2.5	2.0	2.4	1.8	1.9	2.1	2.5	2.0	2.5
BOQ	8.3	17.2	9.0	22.0	17.7	13.1	7.7	16.7	8.3
QSRatio									

ERROR MESSAGES

No errors to report.

Saturday

Midday

HCS+: Signalized Intersections Release 5.4

Analyst: KM Inter.: Veterans Rd W & Arthur Kill Rd
 Agency: AECOM Area Type: All other areas
 Date: 7/16/13 Jurisd: Staten Island, NY
 Period: Saturday 12:45-1:45 PM Peak Pd Year : 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig	LTR			LT R			LTR			L TR		
Volume	0	10	5	399	27	407	5	251	385	265	260	0
Lane Width	15.5			11.0			15.0			10.0		
RTOR Vol	0			0			0			0		

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P				NB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds					Peds			
WB Left	P				SB Left	P		
Thru	P				Thru	P		
Right	P				Right	P		
Peds	X				Peds	X		
NB Right					EB Right			
SB Right					WB Right			
Green	23.0				27.0			
Yellow	3.0				3.0			
All Red	2.0				2.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS

Eastbound

LTR	668	1743	0.02	0.38	11.6	B	11.6	B
-----	-----	------	------	------	------	---	------	---

Westbound

LT	503	1311	0.92	0.38	39.5	D	37.6	D
R	496	1293	0.89	0.38	35.7	D		

Northbound

LTR	815	1811	0.86	0.45	25.2	C	25.2	C
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Southbound

L	228	507	1.28	0.45	170.3	F		
TR	796	1769	0.36	0.45	12.1	B	91.9	F

Intersection Delay = 47.7 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: KM
 Agency/Co.: AECOM
 Date Performed: 7/16/13
 Analysis Time Period: Saturday 12:45-1:45 PM Peak Pd
 Intersection: Veterans Rd W & Arthur Kill Rd
 Area Type: All other areas
 Jurisdiction: Staten Island, NY
 Analysis Year: 2020 Alt 3 Miti-Action Cond
 Project ID: Charleston EIS
 E/W St: Allentown Lane/Veterans Road W N/S St: Arthur Kill Road

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	0	10	5	399	27	407	5	251	385	265	260	0
% Heavy Veh	2	2	2	2	2	2	5	5	5	3	3	3
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
PK 15 Vol	0	3	2	108	7	111	2	69	106	73	71	0
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat		1900			1900	1900		1900		1900	1900	
ParkExist			X			X						
NumPark			5			5						
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
LGConfig		LTR			LT	R		LTR		L	TR	
Lane Width		15.5			11.0	10.0		15.0		10.0	11.0	
RTOR Vol			0			0			0			0
Adj Flow		16			463	442		704		291	286	
%InSharedLn												
Prop LTs		0.000			0.937			0.007		1.000	0.000	
Prop RTs		0.313			0.000	1.000		0.601		0.000		
Peds Bikes	0			0	0		0			0	0	
Buses		0			0	0		2		0	2	
%InProtPhase												
Duration	0.25			Area Type: All other areas								

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet		0.0			0.0	0.0		0.0		0.0	0.0	
Arriv. Type		3			3	3		3		3	3	
Unit Ext.		3.0			3.0	3.0		3.0		3.0	3.0	
I Factor		1.000			0.849			0.861			1.000	
Lost Time		2.0			2.0	2.0		2.0		2.0	2.0	
Ext of g		2.0			2.0	2.0		2.0		2.0	2.0	
Ped Min g		11.5			13.5			15.2			12.1	

PHASE DATA

Phase Combination			1	2	3	4	5	6	7	8
EB	Left	P					NB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds							Peds		
WB	Left	P					SB	Left	P	
	Thru	P						Thru	P	
	Right	P						Right	P	
	Peds	X						Peds	X	
NB	Right						EB	Right		
SB	Right						WB	Right		
Green		23.0							27.0	
Yellow		3.0							3.0	
All Red		2.0							2.0	

Cycle Length: 60.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	0	10	5	399	27	407	5	251	385	265	260	0
PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.91	0.91	0.91
Adj flow	0	11	5	434	29	442	5	276	423	291	286	0
No. Lanes	0	1	0	0	1	1	0	1	0	1	1	0
Lane group	LTR			LT R			LTR			L TR		
Adj flow	16			463 442			704			291 286		
Prop LTs	0.000			0.937			0.007			1.000 0.000		
Prop RTs	0.313			0.000 1.000			0.601			0.000		

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

	Eastbound			Westbound			Northbound			Southbound		
	LTR			LT R			LTR			L TR		
So	1900			1900 1900			1900			1900 1900		
Lanes 0	1	0	0	1	1	0	1	0		1	1	0
fW	1.117			0.967 0.933			1.100			0.933 0.967		
fHV	0.980			0.980 0.980			0.952			0.971 0.971		
fG	1.000			1.000 1.000			1.000			1.000 1.000		
fP	0.875			1.000 0.875			1.000			1.000 1.000		
fBB	1.000			1.000 1.000			0.992			1.000 0.992		
fA	1.000			1.000 1.000			1.000			1.000 1.000		
fLU	1.000			1.000 1.000			1.000			1.000 1.000		
fRT	0.958			1.000 0.850			0.919			1.000		
fLT	1.000			0.728			0.998			0.295 1.000		
Sec.												
fLpb	1.000			1.000			1.000			1.000 1.000		
fRpb	1.000			1.000 1.000			1.000			1.000		
S	1743			1311 1293			1811			507 1769		
Sec.												

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	16	1743	0.01	0.38	668	0.02
Right							
Westbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LT	463	1311	# 0.35	0.38	503	0.92
Right	R	442	1293	0.34	0.38	496	0.89
Northbound							
Prot							
Perm							
Left							
Prot							
Perm							
Thru	LTR	704	1811	0.39	0.45	815	0.86
Right							
Southbound							
Prot							
Perm							
Left	L	291	507	# 0.57	0.45	228	1.28
Prot							
Perm							
Thru	TR	286	1769	0.16	0.45	796	0.36
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.93
Total lost time per cycle, L = 10.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.11

Control Delay and LOS Determination												
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Res Del d2	Res Del d3	Lane Group		Approach	
	v/c	g/C							Delay	LOS	Delay	LOS
Eastbound												
LTR	0.02	0.38	11.5	1.000	668	0.50	0.1	0.0	11.6	B	11.6	B
Westbound												
LT	0.92	0.38	17.6	1.000	503	0.50	21.8	0.0	39.5	D	37.6	D
R	0.89	0.38	17.3	1.000	496	0.50	18.3	0.0	35.7	D		
Northbound												
LTR	0.86	0.45	14.8	1.000	815	0.50	10.3	0.0	25.2	C	25.2	C
Southbound												
L	1.28	0.45	16.5	1.000	228	0.50	153.8	0.0	170.3	F		
TR	0.36	0.45	10.8	1.000	796	0.50	1.3	0.0	12.1	B	91.9	F

Intersection delay = 47.7 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)				27.0
Effective permitted green time for LT lane group, g(s)				27.0
Opposing effective green time, go (s)				27.0
Number of lanes in LT lane group, N				1
Number of lanes in opposing approach, No				1
Adjusted LT flow rate, VLT (veh/h)				291
Proportion of LT in LT lane group, PLT				1.000
Proportion of LT in opposing flow, PLTo				0.01
Adjusted opposing flow rate, Vo (veh/h)				704
Lost time for LT lane group, tL				5.00
Computation				
LT volume per cycle, LTC=VLTC/3600				4.85
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)				11.73
gf=G[exp(- a * (LTC * b))]-tL, gf<=g				0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)				1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]				0.55
gq, (see Exhibit C16-4,5,6,7,8)				12.12
gu=g-gq if gq>=gf, or = g-gf if gq<gf				14.88
n=Max(gq-gf)/2,0)				6.06
PTHo=1-PLTo				0.99
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]				1.00
EL1 (refer to Exhibit C16-3)				2.52
EL2=Max((1-Ptho**n)/Plto, 1.0)				5.95
fmin=2(1+PL)/g or fmin=2(1+PL)/g				0.15
gdifff=max(gq-gf,0)				12.12
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)				0.29
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT				0.295

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.

For special case of multilane approach opposed by single-lane approach or when $g > gq$, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C				60.0 sec
Total actual green time for LT lane group, G (s)	23.0	23.0	27.0	
Effective permitted green time for LT lane group, g(s)	23.0	23.0	27.0	
Opposing effective green time, go (s)	23.0	23.0	27.0	
Number of lanes in LT lane group, N	1	1	1	

Number of lanes in opposing approach, No	1	1	1	
Adjusted LT flow rate, VLT (veh/h)	0	434	5	
Proportion of LT in LT lane group, PLT	0.000	0.937	0.007	0.000
Proportion of LT in opposing flow, PLTo	0.94	0.00	0.00	
Adjusted opposing flow rate, Vo (veh/h)	463	16	286	
Lost time for LT lane group, tL	5.00	5.00	5.00	
Computation				
LT volume per cycle, LTC=VLTC/3600	0.00	7.23	0.08	
Opposing lane util. factor, fLUo	1.000	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	7.72	0.27	4.77	
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	18.3	
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	
Opposing Queue Ratio, gro=Max[1-Rpo(go/C),0]	0.62	0.62	0.55	
gq, (see Exhibit C16-4,5,6,7,8)	9.04	0.00	3.62	
gu=g-gq if gq>=gf, or = g-gf if gq<gf	13.96	23.00	8.73	
n=Max(gq-gf)/2,0)	4.52	0.00	0.00	
PTHo=1-PLTo	0.06	1.00	1.00	
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	0.00	0.94	0.01	
EL1 (refer to Exhibit C16-3)	2.22	1.40	1.85	
EL2=Max((1-Ptho**n)/Plto, 1.0)	1.07			
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.09	0.17	0.07	
gdifff=max(gq-gf,0)	9.04	0.00	0.00	
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.61	0.73	1.00	
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00) or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	1.000	0.728	0.998	

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.
For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	23.0		27.0	
Conflicting pedestrian volume, Vped (p/h)	0		0	
Pedestrian flow rate, Vpedg (p/h)	0		0	
OCCpedg	0.000		0.000	
Opposing queue clearing green, gq (s)	9.04		3.62	
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.393		0.134	
OCCpedu	0.000		0.000	
Opposing flow rate, Vo (veh/h)	463		286	
OCCr	0.000		0.000	
Number of cross-street receiving lanes, Nrec	1		1	
Number of turning lanes, Nturn	1		1	
ApbT	1.000		1.000	
Proportion of left turns, PLT	0.000		0.007	
Proportion of left turns using protected phase, PLTA	0.000		0.000	
Left-turn adjustment, fLpb	1.000		1.000	

Permitted Right Turns

Effective pedestrian green time, gp (s)		23.0		27.0
Conflicting pedestrian volume, Vped (p/h)		0		0
Conflicting bicycle volume, Vbic (bicycles/h)		0		0
Vpedg		0		0
OCCpedg		0.000		0.000
Effective green, g (s)		23.0		27.0
Vbicg		0		0

OCCbicg	0.020	0.020
OCCr	0.000	0.000
Number of cross-street receiving lanes, Nrec	1	1
Number of turning lanes, Nturn	1	1
ApbT	1.000	1.000
Proportion right-turns, PRT	1.000	0.000
Proportion right-turns using protected phase, PRTA	0.000	0.000
Right turn adjustment, fRpb		1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	60.0			sec
Adj. LT vol from Vol Adjustment Worksheet, v				
v/c ratio from Capacity Worksheet, X				
Protected phase effective green interval, g (s)				
Opposing queue effective green interval, gq				
Unopposed green interval, gu				
Red time $r=(C-g-gq-gu)$				
Arrival rate, $qa=v/(3600(\max[X,1.0]))$				
Protected ph. departure rate, $Sp=s/3600$				
Permitted ph. departure rate, $Ss=s(gq+gu)/(gu*3600)$				
XPerm				
XProt				
Case				
Queue at beginning of green arrow, Qa				
Queue at beginning of unsaturated green, Qu				
Residual queue, Qr				
Uniform Delay, d1				

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
LTR	0.0 0.0 0.0	0.00	18.5	11.5	0.00	0.0	0.0 0.0 0.0	11.6
Westbound								
LT	0.0	0.00	18.5	17.6	0.00	0.0	0.0	39.5
R	0.0	0.00	18.5	17.3	0.00	0.0	0.0	35.7
Northbound								
LTR	0.0 0.0 0.0	0.00	16.5	14.8	0.00	0.0	0.0 0.0 0.0	25.2
Southbound								
L	0.0	0.00	16.5	16.5	0.00	15.8	0.0	170.3
TR	0.0 0.0	0.00	16.5	10.8	0.00	0.0	0.0 0.0	12.1
Intersection Delay			47.7	sec/veh	Intersection LOS D			

BACK OF QUEUE WORKSHEET

	Eastbound		Westbound		Northbound		Southbound	
LaneGroup	LTR		LT	R	LTR		L	TR
Init Queue	0.0		0.0	0.0	0.0		0.0	0.0
Flow Rate	16		463	442	704		291	286
So	1900		1900	1900	1900		1900	1900
No.Lanes	0 1 0	0	1 1		0 1 0		1 1 0	
SL	1743		1311	1293	1811		507	1769
LnCapacity	668		503	496	815		228	796
Flow Ratio	0.0		0.4	0.3	0.4		0.6	0.2
v/c Ratio	0.02		0.92	0.89	0.86		1.28	0.36
Grn Ratio	0.38		0.38	0.38	0.45		0.45	0.45
I Factor	1.000		0.849		0.861			1.000
AT or PVG	3		3	3	3		3	3
Pltn Ratio	1.00		1.00	1.00	1.00		1.00	1.00
PF2	1.00		1.00	1.00	1.00		1.00	1.00
Q1	0.2		7.4	6.9	10.6		4.8	3.1
kB	0.6		0.5	0.4	0.6		0.3	0.7
Q2	0.0		3.2	2.6	3.3		9.1	0.4
Q Average	0.2		10.5	9.5	13.8		13.9	3.5
Q Spacing	25.0		25.0	25.0	25.0		25.0	25.0
Q Storage	0		0	0	0		0	0
Q S Ratio								
70th Percentile Output:								
fB%	1.3		1.2	1.2	1.2		1.2	1.2
BOQ	0.2		12.8	11.6	16.7		16.8	4.4
QSRatio								
85th Percentile Output:								
fB%	1.7		1.4	1.4	1.4		1.4	1.5
BOQ	0.3		15.1	13.8	19.6		19.8	5.5
QSRatio								
90th Percentile Output:								
fB%	2.0		1.6	1.6	1.5		1.5	1.7
BOQ	0.4		16.5	15.0	21.2		21.3	6.2
QSRatio								
95th Percentile Output:								
fB%	2.6		1.7	1.7	1.7		1.7	2.1
BOQ	0.5		18.1	16.7	23.0		23.2	7.4
QSRatio								
98th Percentile Output:								
fB%	3.1		1.9	1.9	1.8		1.8	2.4
BOQ	0.6		19.8	18.3	24.8		25.0	8.6
QSRatio								

ERROR MESSAGES

No errors to report.

HCS+: Signalized Intersections Release 5.4

Analyst: ML Inter.: Veterans Rd W & Bricktown/KWVP
 Agency: AECOM Area Type: All other areas
 Date: 08/29/2013 Jurisd: Staten Island
 Period: Saturday 12:45-1:45 PM MD Peak Year : 2020 FULL Mitigation Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Volume	99	428	227	272	679	102	232	479	221	243	140	92
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	P	P			NB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds					Peds			
WB Left	P	P			SB Left	P	P	
Thru	P				Thru	P	P	
Right	P				Right	P	P	
Peds	X				Peds			
NB Right		P			EB Right			
SB Right					WB Right			
Green	27.0	6.0			16.0	11.0	11.0	
Yellow	3.0	3.0			3.0	3.0	3.0	
All Red	0.0	2.0			0.0	0.0	2.0	

Cycle Length: 90.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios		Lane Group		Approach	
			v/c	g/C	Delay	LOS	Delay	LOS
Eastbound								
L	292	1728	0.36	0.40	35.3	D		
T	564	1881	0.82	0.30	38.1	D	35.0+	D
R	448	1492	0.43	0.30	27.4	C		
Westbound								
L	302	1765	0.94	0.41	71.8	E		
TR	1073	3450	0.92	0.31	42.9	D	49.3	D
Northbound								
DefL	402	1787	0.64	0.33	33.1	C		
T	638	1913	0.83	0.33	39.9	D	32.9	C
R	680	1492	0.36	0.46	17.5	B		
Southbound								
L	392	1728	0.74	0.28	41.8	D		
TR	459	1651	0.60	0.28	33.2	C	37.6	D

Intersection Delay = 39.8 (sec/veh) Intersection LOS = D

Phone:
E-Mail:

Fax:

OPERATIONAL ANALYSIS

Analyst: ML
 Agency/Co.: AECOM
 Date Performed: 08/29/2013
 Analysis Time Period: Saturday 12:45-1:45 PM MD Peak
 Intersection: Veterans Rd W & Bricktown/KWVP
 Area Type: All other areas
 Jurisdiction: Staten Island
 Analysis Year: 2020 FULL Mitigation Alt. 3
 Project ID: Charleston EIS
 E/W St: Veterans Road West N/S St: KWVP WB Off-Ramp/Bricktown Way

VOLUME DATA

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume	99	428	227	272	679	102	232	479	221	243	140	92
% Heavy Veh	1	1	1	3	3	3	1	1	1	1	1	1
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
PK 15 Vol	27	115	61	71	218	33	64	133	61	72	42	27
Hi Ln Vol												
% Grade		0			0			0			0	
Ideal Sat	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
ParkExist												
NumPark												
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
LGConfig	L	T	R	L	TR		DefL	T	R	L	TR	
Lane Width	11.0	12.0	10.0	10.0	12.0		12.0	12.5	10.0	11.0	10.0	
RTOR Vol			48			11			0			0
Adj Flow	106	460	192	283	988		258	532	246	289	277	
%InSharedLn												
Prop LTS	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTS		0.000	1.000		0.118			0.000	1.000		0.397	
Peds Bikes	0			0	0	0	0			0		
Buses	0	0	0	0	0		0	0	0	0	0	
%InProtPhase	0.0			0.0			0.0			0.0		
Duration	0.25											
Area Type: All other areas												

OPERATING PARAMETERS

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Init Unmet	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	
Arriv. Type	3	3	3	3	3		3	3	3	3	3	
Unit Ext.	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	
I Factor		0.700			0.903			1.000			0.855	
Lost Time	2.0	2.0	2.0	2.0	2.0		2.0	2.0	2.0	2.0	2.0	
Ext of g	2.0	2.0	2.0	3.0	3.0		2.0	2.0	2.0	2.0	2.0	
Ped Min g		34.6			18.6			20.3			16.1	

PHASE DATA

Phase Combination		1	2	3	4	5	6	7	8
EB	Left	P	P			NB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds						Peds		
WB	Left	P	P			SB	Left	P	P
	Thru	P					Thru	P	P
	Right	P					Right	P	P
	Peds	X					Peds		
NB	Right		P			EB	Right		
SB	Right					WB	Right		
Green		27.0	6.0				16.0	11.0	11.0
Yellow		3.0	3.0				3.0	3.0	3.0
All Red		0.0	2.0				0.0	0.0	2.0

Cycle Length: 90.0 secs

VOLUME ADJUSTMENT AND SATURATION FLOW WORKSHEET

Volume Adjustment

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Volume, V	99	428	227	272	679	102	232	479	221	243	140	92
PHF	0.93	0.93	0.93	0.96	0.78	0.78	0.90	0.90	0.90	0.84	0.84	0.84
Adj flow	106	460	192	283	871	117	258	532	246	289	167	110
No. Lanes	1	1	1	1	2	0	0	2	1	1	1	0
Lane group	L	T	R	L	TR		DefL	T	R	L	TR	
Adj flow	106	460	192	283	988		258	532	246	289	277	
Prop LTs	1.000	0.000		1.000	0.000		1.000	0.000		1.000	0.000	
Prop RTs		0.000	1.000		0.118			0.000	1.000		0.397	

Saturation Flow Rate (see Exhibit 16-7 to determine the adjustment factors)

LG	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	TR		DefL	T	R	L	TR	
So	1900	1900	1900	2050	1900		1900	1900	1900	1900	1900	
Lanes	1	1	1	1	2	0	0	2	1	1	1	0
fW	0.967	1.000	0.933	0.933	1.000		1.000	1.017	0.933	0.967	0.933	
fHV	0.990	0.990	0.990	0.971	0.971		0.990	0.990	0.990	0.990	0.990	
fG	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fP	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fBB	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fA	1.000	1.000	1.000	1.000	1.000		1.000	1.000	1.000	1.000	1.000	
fLU	1.000	1.000	1.000	1.000	0.952		1.000	1.000	1.000	1.000	1.000	
fRT		1.000	0.850		0.982			1.000	0.850		0.940	
fLT	0.950	1.000		0.950	1.000		0.950	1.000		0.950	1.000	
Sec.	0.160			0.160			0.286			0.466		
fLpb	1.000	1.000		1.000	1.000		1.000	1.000		1.000	1.000	
fRpb		1.000	1.000		1.000			1.000	1.000		1.000	
S	1728	1881	1492	1765	3450		1787	1913	1492	1728	1651	
Sec.	291			298			537			848		

CAPACITY AND LOS WORKSHEET

Capacity Analysis and Lane Group Capacity

Appr/ Mvmt	Lane Group	Adj Flow Rate (v)	Adj Sat Flow Rate (s)	Flow Ratio (v/s)	Green Ratio (g/C)	--Lane Group-- Capacity (c)	v/c Ratio
Eastbound							
Prot		25	1728	0.01	0.122	211	0.12
Perm		81	291	0.28	0.278	81	1.00
Left	L	106			0.40	292	0.36
Prot							
Perm							
Thru	T	460	1881	0.24	0.30	564	0.82
Right	R	192	1492	0.13	0.30	448	0.43
Westbound							
Prot		197	1765	# 0.11	0.122	216	0.91
Perm		86	298	# 0.29	0.289	86	1.00
Left	L	283			0.41	302	0.94
Prot							
Perm							
Thru	TR	988	3450	0.29	0.31	1073	0.92
Right							
Northbound							
Prot		258	1787	0.14	0.178	318	0.81
Perm		0	537	0.00	0.156	84	0.00
Left	DefL	258			0.33	402	0.64
Prot							
Perm							
Thru	T	532	1913	# 0.28	0.33	638	0.83
Right	R	246	1492	0.16	0.46	680	0.36
Southbound							
Prot		204	1728	# 0.12	0.178	307	0.66
Perm		85	848	# 0.10	0.100	85	1.00
Left	L	289			0.28	392	0.74
Prot							
Perm							
Thru	TR	277	1651	0.17	0.28	459	0.60
Right							

Sum of flow ratios for critical lane groups, Yc = Sum (v/s) = 0.90
Total lost time per cycle, L = 12.00 sec
Critical flow rate to capacity ratio, Xc = (Yc)(C)/(C-L) = 1.03

Control Delay and LOS Determination													
Appr/ Lane Grp	Ratios		Unf Del d1	Prog Adj Fact	Lane Grp Cap	Incremental Factor k	Del d2	Res Del d3	Lane Group		Approach		
	v/c	g/C							Delay	LOS	Delay	LOS	
Eastbound													
L	0.36	0.40	32.8	1.000	292	0.50	2.4	0.0	35.3	D			
T	0.82	0.30	29.2	1.000	564	0.50	8.9	0.0	38.1	D	35.0+	D	
R	0.43	0.30	25.3	1.000	448	0.50	2.1	0.0	27.4	C			
Westbound													
L	0.94	0.41	36.2	1.000	302	0.50	35.5	0.0	71.8	E			
TR	0.92	0.31	29.9	1.000	1073	0.50	12.9	0.0	42.9	D	49.3	D	
Northbound													
DefL	0.64	0.33	25.5	1.000	402	0.50	7.7	0.0	33.1	C			
T	0.83	0.33	27.7	1.000	638	0.50	12.2	0.0	39.9	D	32.9	C	
R	0.36	0.46	16.0	1.000	680	0.50	1.5	0.0	17.5	B			
Southbound													
L	0.74	0.28	31.6	1.000	392	0.50	10.1	0.0	41.8	D			
TR	0.60	0.28	28.2	1.000	459	0.50	5.0	0.0	33.2	C	37.6	D	

Intersection delay = 39.8 (sec/veh) Intersection LOS = D

SUPPLEMENTAL PERMITTED LT WORKSHEET

for exclusive lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)	36.0	36.0	30.0	25.0
Effective permitted green time for LT lane group, g(s)	25.0	26.0	14.0	9.0
Opposing effective green time, go (s)	28.0	27.0	25.0	30.0
Number of lanes in LT lane group, N	1	1	1	1
Number of lanes in opposing approach, No	2	1	1	2
Adjusted LT flow rate, VLT (veh/h)	106	283	258	289
Proportion of LT in LT lane group, PLT	1.000	1.000	1.000	1.000
Proportion of LT in opposing flow, PLTo	0.00	0.00	0.00	0.00
Adjusted opposing flow rate, Vo (veh/h)	988	460	277	532
Lost time for LT lane group, tL	5.00	4.00	3.00	5.00
Computation				
LT volume per cycle, LTC=VLTC/3600	2.65	7.08	6.45	7.23
Opposing lane util. factor, fLUo	0.952	1.000	1.000	1.000
Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)	12.97	11.50	6.93	6.65
gf=G[exp(- a * (LTC ** b))]-tL, gf<=g	0.0	0.0	0.0	0.0
Opposing platoon ratio, Rpo (refer Exhibit 16-11)	1.00	1.00	1.00	1.00
Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]	0.69	0.70	0.72	0.67
gq, (see Exhibit C16-4,5,6,7,8)	20.11	17.63	11.82	0.00
gu=g-gq if gq>=gf, or = g-gf if gq<gf	4.89	8.37	2.18	9.00
n=Max(gq-gf)/2,0)	10.06	8.81	5.91	0.00
PTHo=1-PLTo	1.00	1.00	1.00	1.00
PL*=PLT[1+(N-1)g/(gf+gu/EL1+4.24)]	1.00	1.00	1.00	1.00
EL1 (refer to Exhibit C16-3)	3.44	2.01	1.70	2.15
EL2=Max((1-Ptho**n)/Plto, 1.0)				
fmin=2(1+PL)/g or fmin=2(1+Pl)/g	0.16	0.15	0.29	0.44
gdifff=max(gq-gf,0)	0.00	0.00	0.00	0.00
fm=[gf/g]+[gu/g]/[1+PL(EL1-1)], (min=fmin;max=1.00)	0.16	0.16	0.29	0.47
flt=fm=[gf/g]+[gu/g]/[1+PL(EL1-1)]+[gdifff/g]/[1+PL(EL2-1)], (fmin<=fm<=1.00)				
or flt=[fm+0.91(N-1)]/N**				
Left-turn adjustment, fLT	0.160	0.160	0.286	0.466

For special case of single-lane approach opposed by multilane approach, see text.

* If Pl>=1 for shared left-turn lanes with N>1, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, flt=fm.

For special case of multilane approach opposed by single-lane approach or when gf>gq, see text.

SUPPLEMENTAL PERMITTED LT WORKSHEET

for shared lefts

Input

	EB	WB	NB	SB
Opposed by Single(S) or Multiple(M) lane approach				
Cycle length, C 90.0 sec				
Total actual green time for LT lane group, G (s)				
Effective permitted green time for LT lane group, g(s)				
Opposing effective green time, go (s)				
Number of lanes in LT lane group, N				

Number of lanes in opposing approach, No
 Adjusted LT flow rate, VLT (veh/h)
 Proportion of LT in LT lane group, PLT 0.000 0.000 0.000 0.000
 Proportion of LT in opposing flow, PLTo
 Adjusted opposing flow rate, Vo (veh/h)
 Lost time for LT lane group, tL
 Computation
 LT volume per cycle, LTC=VLTC/3600
 Opposing lane util. factor, fLUo 0.952 1.000 1.000 1.000
 Opposing flow, Volc=VoC/[3600(No)fLUo] (veh/ln/cyc)
 $gf = G[\exp(-a * (LTC * b))] - tL$, $gf \leq g$
 Opposing platoon ratio, Rpo (refer Exhibit 16-11)
 Opposing Queue Ratio, qro=Max[1-Rpo(go/C),0]
 gq, (see Exhibit C16-4,5,6,7,8)
 $gu = g - gq$ if $gq \geq gf$, or $= g - gf$ if $gq < gf$
 $n = \text{Max}(gq - gf) / 2, 0$
 $PTHo = 1 - PLTo$
 $PL^* = PLT[1 + (N - 1)g / (gf + gu / EL1 + 4.24)]$
 EL1 (refer to Exhibit C16-3)
 $EL2 = \text{Max}((1 - Ptho * n) / PLto, 1.0)$
 $fmin = 2(1 + PL) / g$ or $fmin = 2(1 + PL) / g$
 $gdifff = \text{max}(gq - gf, 0)$
 $fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)]$, (min=fmin;max=1.00)
 $flt = fm = [gf / g] + [gu / g] / [1 + PL(EL1 - 1)] + [gdifff / g] / [1 + PL(EL2 - 1)]$, (fmin<=fm<=1.00)
 or $flt = [fm + 0.91(N - 1)] / N^{**}$
 Left-turn adjustment, fLT

For special case of single-lane approach opposed by multilane approach, see text.

* If $PL \geq 1$ for shared left-turn lanes with $N > 1$, then assume de-facto left-turn lane and redo calculations.

** For permitted left-turns with multiple exclusive left-turn lanes, $flt = fm$.
 For special case of multilane approach opposed by single-lane approach or when $gf > gq$, see text.

SUPPLEMENTAL PEDESTRIAN-BICYCLE EFFECTS WORKSHEET

Permitted Left Turns

	EB	WB	NB	SB
Effective pedestrian green time, gp (s)	27.0			
Conflicting pedestrian volume, Vped (p/h)	0			
Pedestrian flow rate, Vpedg (p/h)	0			
OCCpedg	0.000			
Opposing queue clearing green, gq (s)	20.11			
Eff. ped. green consumed by opp. veh. queue, gq/gp	0.745			
OCCpedu	0.000			
Opposing flow rate, Vo (veh/h)	988			
OCCr	0.000			
Number of cross-street receiving lanes, Nrec	2			
Number of turning lanes, Nturn	1			
ApbT	1.000			
Proportion of left turns, PLT	1.000			
Proportion of left turns using protected phase, PLTA	0.000			
Left-turn adjustment, fLpb	1.000			
Permitted Right Turns				
Effective pedestrian green time, gp (s)		27.0		
Conflicting pedestrian volume, Vped (p/h)		0		
Conflicting bicycle volume, Vbic (bicycles/h)		0		
Vpedg		0		
OCCpedg		0.000		
Effective green, g (s)		28.0		
Vbicg		0		

OCCbicg	0.020
OCCr	0.000
Number of cross-street receiving lanes, Nrec	2
Number of turning lanes, Nturn	1
ApbT	1.000
Proportion right-turns, PRT	0.118
Proportion right-turns using protected phase, PRTA	0.000
Right turn adjustment, fRpb	1.000

SUPPLEMENTAL UNIFORM DELAY WORKSHEET

	EBLT	WBLT	NBLT	SBLT
Cycle length, C	90.0			
Adj. LT vol from Vol Adjustment Worksheet, v	106	283	258	289
v/c ratio from Capacity Worksheet, X	0.36	0.94	0.64	0.74
Protected phase effective green interval, g (s)	11.0	11.0	16.0	16.0
Opposing queue effective green interval, gq	20.11	17.63	7.82	0.00
Unopposed green interval, gu	4.89	8.37	4.00	9.00
Red time r=(C-g-gq-gu)	54.0	53.0	62.2	65.0
Arrival rate, qa=v/(3600(max[X,1.0]))	0.03	0.08	0.07	0.08
Protected ph. departure rate, Sp=s/3600	0.480	0.490	0.496	0.480
Permitted ph. departure rate, Ss=s(gq+gu)/(gu*3600)	0.41	0.26	0.68	0.24
XPerm	1.15	2.89	0.31	2.80
XProt			0.71	
Case	5	5	1	5
Queue at beginning of green arrow, Qa	0.31	4.06	4.46	3.82
Queue at beginning of unsaturated green, Qu	2.18	5.55	0.56	5.22
Residual queue, Qr	0.00	0.00	0.00	0.00
Uniform Delay, d1	32.8	36.2	25.5	31.6

DELAY/LOS WORKSHEET WITH INITIAL QUEUE

Appr/ Lane Group	Initial Unmet Demand Q veh	Dur. Unmet Demand t hrs.	Uniform Delay		Initial Queue Param. u	Final Unmet Demand Q veh	Initial Queue Delay d3 sec	Lane Group Delay d sec
			Unadj. ds	Adj. d1 sec				
Eastbound								
L	0.0	0.00		32.8	0.00	0.0	0.0	35.3
T	0.0	0.00	31.5	29.2	0.00	0.0	0.0	38.1
R	0.0	0.00	31.5	25.3	0.00	0.0	0.0	27.4
Westbound								
L	0.0	0.00		36.2	0.00	0.0	0.0	71.8
TR	0.0	0.00	31.0	29.9	0.00	0.0	0.0	42.9
	0.0						0.0	
Northbound								
DefL	0.0	0.00		25.5	0.00	0.0	0.0	33.1
T	0.0	0.00	30.0	27.7	0.00	0.0	0.0	39.9
R	0.0	0.00	24.5	16.0	0.00	0.0	0.0	17.5
Southbound								
L	0.0	0.00		31.6	0.00	0.0	0.0	41.8
TR	0.0	0.00	32.5	28.2	0.00	0.0	0.0	33.2
	0.0						0.0	

Intersection Delay	39.8	sec/veh	Intersection LOS	D
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BACK OF QUEUE WORKSHEET

	Eastbound			Westbound		Northbound			Southbound		
LaneGroup	L	T	R	L	TR	DefL	T	R	L	TR	
Init Queue	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Flow Rate	106	460	192	283	518	258	532	246	289	277	
So	1900	1900	1900	2050	1900	1900	1900	1900	1900	1900	
No.Lanes	1	1	1	1	2	0	2	1	1	1	0
SL	730	1881	1492	734	1811	1204	1913	1492	1411	1651	
LnCapacity	292	564	448	302	563	402	638	680	392	459	
Flow Ratio	0.1	0.2	0.1	0.4	0.3	0.2	0.3	0.2	0.2	0.2	
v/c Ratio	0.36	0.82	0.43	0.94	0.92	0.64	0.83	0.36	0.74	0.60	
Grn Ratio	0.40	0.30	0.30	0.41	0.31	0.33	0.33	0.46	0.28	0.28	
I Factor		0.700			0.903		1.000			0.855	
AT or PVG	3	3	3	3	3	3	3	3	3	3	
Pltn Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
PF2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Q1	1.7	10.7	3.9	4.7	12.5	4.9	12.3	4.0	6.0	6.0	
kB	0.3	0.5	0.5	0.4	0.7	0.6	0.8	0.9	0.5	0.6	
Q2	0.2	2.0	0.3	3.0	4.4	1.0	3.3	0.5	1.3	0.8	
Q Average	1.9	12.7	4.2	7.7	16.9	5.9	15.6	4.5	7.3	6.8	
Q Spacing	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	
Q Storage	0	0	0	0	0	0	0	0	0	0	
Q S Ratio											
70th Percentile Output:											
fB%	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	
BOQ	2.4	15.3	5.2	9.4	20.4	7.2	18.8	5.6	8.9	8.4	
QSRatio											
85th Percentile Output:											
fB%	1.6	1.4	1.5	1.5	1.4	1.5	1.4	1.5	1.5	1.5	
BOQ	3.0	18.1	6.4	11.2	23.9	8.8	22.1	6.8	10.7	10.1	
QSRatio											
90th Percentile Output:											
fB%	1.8	1.5	1.7	1.6	1.5	1.7	1.5	1.7	1.6	1.6	
BOQ	3.4	19.6	7.2	12.3	25.7	9.7	23.8	7.7	11.8	11.1	
QSRatio											
95th Percentile Output:											
fB%	2.3	1.7	2.0	1.8	1.6	1.9	1.6	2.0	1.8	1.9	
BOQ	4.2	21.3	8.5	13.9	27.7	11.2	25.7	9.0	13.4	12.7	
QSRatio											
98th Percentile Output:											
fB%	2.7	1.8	2.3	2.0	1.8	2.2	1.8	2.3	2.0	2.1	
BOQ	5.1	23.1	9.8	15.5	29.7	12.7	27.6	10.4	14.9	14.2	
QSRatio											

ERROR MESSAGES

No errors to report.

